

MEMOIRS

OF THE

ROYAL ACADEMY

OF

SCIENCES in *PARIS*

EPITOMIZED.

WITH THE

LIVES of the late MEMBERS
of that SOCIETY.

AND A

PREFACE by Monsieur *FONTENELLE*,
Secretary and Author of the HISTORY of
the said ACADEMY.



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MEMOIRS

OF THE

ROYAL ACADEMY

OF

SCIENCES IN PARIS

PRESENTED

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RESEARCHES IN THE HISTORY OF
THE ROYAL ACADEMY OF SCIENCES
IN PARIS



TO THE
Right Honourable
The Lord PARKER,
Lord Chief-Justice of *ENGLAND*,
&c. &c.

MY LORD,



Can make no other
Apology for Inscri-
bing these Papers to
You, without your
consent or knowledge,
but that if I had had the Happi-
ness of being acquainted with a
Wiser, Better, or more Learned
Man

Dedication.

Man than your Self, You should not have been troubled with them : This being premised, allow me, my Lord, to give You a short Account of my Project. Among all kinds of History, I have been a great Admirer of that which goes by the Name of *Biography*, or an Account of the *Lives of Great and Good Men*, because of the Usefulness of it, both to the present Age and to Posterity : Every body knows how much more weight Examples have than Precepts ; and I need not tell any body here in *England*, that the Behaviour of a Lord *Parker* has made more *Mathematicians*, *Philosophers*, and *Divines* too, among the *Gentlemen of the Long Robe*, than even Sermons, or the Lectures of our most Learned Profef-

Dedication.

Professors. These Thoughts put me formerly upon making a Collection of the Lives of some of the most famous Men of our own Nation for any particular Art or Science, but the Project was too big for me, and so I let it drop: Since then I happen'd to fall upon the *History of the Royal Academy of Sciences in French*, published by the Learned and Ingenious Monsieur *Fontenelle*, Author of the *History of Oracles*, *Plurality of the Worlds*, *Dialogues of the Dead*, &c. which your Lordship has seen and read, and which I am sure You could neither see nor read, without admiring. This Monsieur *Fontenelle*, my Lord, succeeded Monsieur *Dubamel* in the Office of Secretary to the above-mention'd Academy, as

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he tells us himself in the Life of that great Philosopher, and has publish'd all the Transactions of that learned Body of Men by way of Annals, beginning with the Year 1699, (which was the *Era* of their Re-establishment) and ending with the Year 1712. His Stile is inimitable, and therefore I don't doubt but I have wrong'd him by my Poor and Literal Version; but the Pleasure I shall give, for all that, to such of my Inquisitive Countrymen, that don't understand *French*, will perhaps atone for my Presumption.

My Lord, Among other curious Matters compriz'd in the said History, as often as any Member died it was the Business of the Secretary to make his *Elogy*, as *Monf. Fontenelle*

Dédication.

tenelle calls it, that is to say, a *Fu-
neral Oration*, in which he gives an
Account of the most remarkable
Passages of the Life of their late
Member, especially with respect to
the Books and Papers publish'd or
left in MS. behind him. This
had so near a Relation to my be-
loved Project of Publishing the
Lives of Great Men, that I imme-
diately set my self about Translating
those *Elogies*; and in a few Months,
during my Recess in the Country
the last Summer, I finish'd not
only the Account of all those
French Philosophers that have died
since the last Establishment, but,
upon the Request of my Book-
seller, who himself is a Retainer to
Philosophy, being employ'd in Print-
ing the Transactions of that Illu-
strious

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strious Society (of which your Lordship is one of the Greatest, and I the meanest Member) I have proceeded to Translate some of the most curious Relations of Philosophical Matters; in doing which I have affected to join the *Utile* with the *Dulce*, according to the Poet's Advice; and where I could, to give the Extract of such Pieces as proceeded from some of those Ingenious Men, whose Lives have been accounted for before. I intended to have closed the Whole, my Lord, with what Mons. Fontenelle calls *Various Observations upon Physicks in General*, which contains the *History of Surprizing Phenomenons in Natural Philosophy*, that from Year to Year have been communicated to the Academy from all Parts of the

Dedication.

the World, and which, by reason of the Variety of the Subjects, could not be ranged under peculiar Heads ; but finding the Work already grown too big under my Hands, I shall reserve this last Part for another Opportunity.

In short, my Lord, the whole Book is an Abstract of some of the Choicest Pieces, Memoirs, Dissertations, &c. that have been brought or sent from time to time to the *Academy of Sciences*, mostly by their own Members, within the compass of Thirteen or Fourteen Years, and dispers'd through almost twenty Volumes, in which there is still so good Gleaning, that if what I have now Publish'd be agreeable to your Lordship, and in any manner
useful

Dedication.

useful to my Country, and it
shall please God to continue me
the Health and Leisure I now
enjoy, your Lordship's Com-
mands shall always direct the Use
of both, whenever You signifie
the same to,

Westminster 25.
March 1717.

My Lord,

Your Lordship's most Faithful

Humble and Obliged Servant,

John Chamberlayne.

POST-

POSTSCRIPT.

My LORD, I think my self bound to mention, by way of Postscript, a kind of a Negative Injustice and Affront which the Ingenious Historian of the Transactions of the *Academy* has put upon our Nation, and more immediately upon the *Royal Society*. Your Lordship will observe in the Lives of the Marquis *de L'Hopital*, and Messieurs *Viviani*, *Guglielmini*, and *Bernoulli*, Four of the greatest *Mathematicians* of *Europe*, and all Members of the said *Academy*, that there is an Account given of the *Differential Calculation*, and the Invention thereof, which I think is every where ascribed to the late Monsr. *Leibnitz*, a Privy-Counsellor and Historiographer of his Majesty, as Elector of *Brunswick-Lunenbergh*, and one of the most Learned Men of our Age; at least it is no where attributed, as it ought, to our own Countryman Sir *Isaac Newton*, the First Mathematician in the World. Now it is notorious that the Writers of the *Acta Leipsiensia* make Monsr. *Leibnitz* the Author of the said *Differential Calculation*; but it is not less known to your Lordship, that Dr. *Keill*, in the *Commercium Epistolicum*, has done our *British Philosopher* justice; and has fully proved that which Mr. L. did in some manner acknowledge to me (when I attempted to reconcile these two Great Men) that Sir *I. N.* might be the first Invention, but that he himself had luckily fallen about the same Time upon the same Notions.

THE

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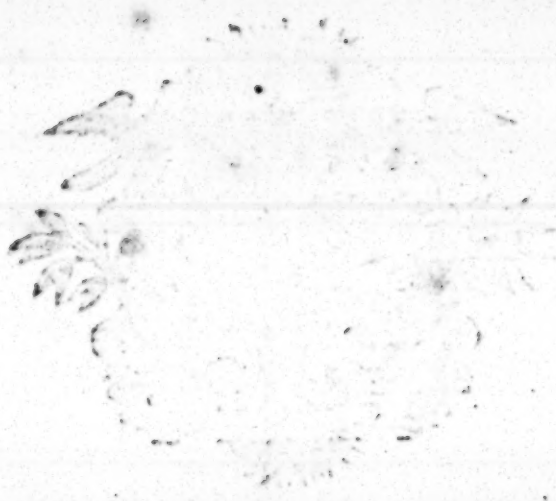
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THE CONTENTS OF THE
HISTORICAL RECORDS OF
THE CITY OF NEW YORK
FROM 1625 TO 1898
IN SEVEN VOLUMES
PUBLISHED BY THE
CITY OF NEW YORK
1898





THE PREFACE

THE Account of the *French Academy of Sciences* consists of two Parts; the first which we call more particularly the *Historical Part*, is an Extract and Abridgment of all the remarkable Things that have been reported to that Society, either by Writing or Word of Mouth. The second are the *Memoirs*, that is to say, some of those Pieces read in the *Academy*, and esteem'd the most important, and most worthy to be communicated to the Publick at their whole Length.

The *Memoirs* are in a manner what we call in a common History, the Authentick Acts, or Documents, and are published with the same, by way of Appendix.

This *Historical Part* comprehends more than the *Memoirs*, being a Collection of such Matters as were not thought proper to be deduced at length, and yet ought by no Means to be entirely omitted;
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and whether it treated of Subjects that were common to the *Memoirs*, or distinct from them, it was thought most proper to bring it down to the reach of all such as have but a moderate Tincture of the Mathematicks, or of Natural Philosophy: We have therefore endeavoured to render this History, as near as we could, intelligible to all Sorts of Persons, and have taken care to interpose occasionally, such Explanations as may facilitate the reading the *Memoirs*, some of which might perhaps be more clearly understood, if they were joyned to that Part of the History that tallies with them.

When we met with a Subject that would not bear turning another way, nor to be treated of more superficially than it was in the *Memoirs*, which happens sometimes in the Case of Machines, or in Demonstrations, Geometry and Algebra; we have been forced to pass them over in silence, unless there was occasion of giving some Historical Account of the Progress that had been made therein, or to relate the News to those who would at least be very glad to hear of the Advancement made of any particular Art or Science.

And on the contrary, when a Matter contained in the *Memoirs* was so intelligible, that it could not be render'd more plain by the History, we have spared the unnecessary Pains of repeating it.

In general, we have been of Opinion, that for the sake of those that were but superficially, as well as of those that were profoundly Learned, it would not be amiss to present under two different Forms, the Matters which compose this Collection, by which Means the Labours of the *Academy* would

The PREFACE.

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be better known, and the Taste and Relish of Sciences would be more enlarged.

But to what purpose is it to extend the Love of Mathematicks, and of Philosophy, and of what Use are these Labours of the *Academy*? This is a very common Question, and which indeed the most part of the World will hardly allow to be so much as a Question.

We readily look upon that which we don't understand as useless and unprofitable; 'tis a kind of Revenge we take upon Learning; and forasmuch as Philosophy and Mathematicks are generally but little known, they do as generally pass for useless Things. The Source of this Unhappiness is plain, they are *Wild* and *Thorny*, and very hard to come at.

We have one Moon to light us during the Night; What is it to us (say they) if *Jupiter* has four? What occasion is there for so many painful Observations, so many tedious Calculations to discover exactly the Course of them? They will not yield us the more Light for it; and Nature, which has placed these little Stars out of the reach of our Eyes, does not seem to have made them for us. In Consequence of such plausible Reasonings is, that we ought not to have observed them with the Telescope; and if we had not, it is certain that we had been great Losers; for those that understand never so little the Principles of Geography and of Navigation, know, that since the Discovery of *Jupiter's* Moons, they have been more useful to us, with respect to those Sciences, than even our own Moon; and that they serve, and will always serve more and more to make our Sea-Charts incomparably

more exact than the ancient ones, and thereby will probably save the Lives of an infinite number of Sailors. If in the whole Science of Astronomy there were no other Advantage than that which is produced by the Discovery of *Jupiter's* Moons, it would sufficiently justify those vast Calculations, those constant and nice Observations, that great Apparatus of Instruments wrought with so much Care, and that noble Edifice, erected solely for the Use of this Science. In the mean time the Mass of Mankind either knows nothing of these Satellites or Moons of *Jupiter*, unless it be by hear-say, and very confusedly, or are entirely ignorant of the Connexion it has with the Art of Navigation; or do not so much as know that that Art is become more perfect in the present Age.

Such is the Fate of those Sciences, that are in the hands of a small Number of Persons; the Advantage of their Progress is invisible to the greatest part of the World, especially if they are shut up in such Professions as do not make a great Noise. Why are we arrived at a greater Facility in this Age to carry on Rivers, make Canals, and establish new Navigations? Why, it is because we understand much better the Art of *Levelling* a Country, and of making *Sluices*.

Builders and Mariners have been eased in their Labours, without so much as discovering the Skill of the *Geometrician* that help'd them; they have been moved in a manner, as the Body is by the Soul, without so much as knowing it; the rest of the World are yet less able to discover the Genius which presides over any Enterprize; and it is with
a kind

The PREFACE.

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a kind of an Ungratitude that the Publick enjoys the Success thereof,

The Science of Anatomy, which of late has been so carefully studied, could not become more exact without rendring the Art of Surgery more safe in its Operations. This the Surgeons know very well ; but those that reap the Benefit of their Art, know nothing of the matter ; And how should they ? They must compare the Ancient Surgery with the Modern ; that would be a great Study, and by no means agreeable to them. The Operation has succeeded, and that is enough ; What need is there of knowing whether in another Age the Success would have been equal ?

'Tis amazing to consider how many things stand before our Eyes without our perceiving them : The Shops of Artificers shine on all sides with Ingenuity and Invention, which nevertheless do not attract our Observations ; Spectators are wanting to the most useful Instruments and most ingenious Works, and nothing would be more *Marvellous*, to such as knew how to be affected therewith.

If a Society of Learned Men have, by their noble Endeavours, brought to a greater Perfection *Geometry*, *Anatomy*, the *Mechanicks*, or any other useful Science, we must not pretend to seek out this remote Spring to make known our Obligations to them, and to do Honour to the Usefulness of their Discoveries. It will always be more easie to the Publick to enjoy the Advantages that arise from thence, than to attain to the Knowledge thereof. The Determination of the *Longitudes* by *Jupiter's Moons*, the Discovery of the *Ductus Thoracicus*, a more convenient and exact Method of

Levelling are not such kind of Novelties as will make a noise like a fine *Poem*, or an eloquent *Harangue*.

The Advantage of the *Mathematicks*, and of *Natural Philosophy*, tho' indeed not very evident, are not the less solid or real. If Men were only to be consider'd in their Natural State, nothing is more useful to them, than that which tends to preserve Life, and to produce those Arts which are so necessary and so ornamental to Society.

That which relates to the Preservation of Life, is particularly the Object of *Natural Philosophy*; and with this view it is divided by the Society into three Branches, which makes three different kinds of Professors, *Anatomy*, *Chymistry* and *Eotany*. It is easie to see, how greatly it imports us to know exactly Humane Bodies, and the Remedies or Medicines that may be drawn from *Plants* and *Minerals*.

As for the *Arts*, the Reckoning up of which would be infinite, some of 'em depend upon *Natural Philosophy*, and others upon *Mathematicks*.

It seems at first that if one would only regard what is profitable in *Mathematicks*, one should not cultivate them any farther, than as they have an immediate and sensible Relation to *Arts*, and leave all the rest as a vain Theory: But such an Idea of the *Mathematicks* would be very false.

The Art of *Navigation*, for instance, has a necessary Connexion with *Astronomy*; on which Account, the Study of the latter can never be carried too far for the Interest of the former. *Astronomy* has an indispensable occasion of *Opticks*, on account of long Perspective-Glasses; and both the

one and the other, as well as all the Parts of *Mathematicks*, are founded upon *Geometry*; and if you will go to the end of 'em, even upon *Algebra* it self.

Geometry, and especially *Algebra*, is the Key of all the Enquiries that can be made into *Magnitude*. These Sciences, which do only concern themselves with abstracted Relations and simple Idea's, may appear unfruitful, so long as they do not go out, as one may say, of the Intellectual World; but mixed *Mathematicks*, which descend to Matter, and which consider the *Motions* of the *Stars*, the *Augmentation* of *Moving Powers*, the different Ways made by the *Rays* of *Light* in different *Mediums*, the different Effects of *Sound* by the *Vibrations* of *Strings*, in a word, all the Sciences that discover the particular Relations of sensible *Magnitudes*, go so much the farther, and with so much greater Certainty, as the Art of discovering Relations in general is more perfect. An universal Instrument cannot have too great an Extent, nor be too handy, nor too easie to be applied to every thing we desire to observe; it is so useful, that no Science can be without its Assistance; for which reason it is, that among the *Mathematicians* of the *Academy*, from whom the Publick is to expect any Advantage, the *Geometricians*, or *Algebraists* make one Class, as well as the *Astronomers* and the *Mechanists*.

Nevertheless it is true, that all the Speculations of pure *Geometry* or *Algebra* are not applicable to useful things; but it is true also, that the most part of those which are not immediately applicable, do lead to, or are connected with those that are so. To know, that in a Parabola the *Sub-tangent* is double to the

Correspondent Abfisse, is a Knowledge very barren in it self ; but for all that, one cannot without it attain to the Skill of throwing *Bombs* with that Exactness of which we are now Masters. In the *Mathematicks*, there are much fewer evident Uses, than Propositions or Truths ; and it is well if the Concurrence of several Truths do always produce one single Use. Moreover, there are *Geometrical Speculations*, which tho' not immediately applicable to any thing useful, may in the Consequences become so. When the greatest *Geometricians* in the Seventeenth Century set themselves to Study a new *Curve*, which they called a *Cycloide*, it was at first but a pure Speculation, to which they were excited by the Vanity of excelling each other in the Discovery of different Theorems : They themselves did not pretend to labour for the Publick Good ; and yet it has happened, that their diving thus into the Nature of the *Cycloide* has been the occasion of advancing *Pendulums* to the utmost Perfection, and measuring Time with the greatest Exactness.

It is the same with *Philosophy* as with *Geometry*. The *Anatomy* of *Animals* should seem to be a very indifferent matter to us, we are only concerned to know the Humane Body : But such a part, which in the Bodies of Men is of so nice or so confused a Structure as renders it invisible, becomes sensible and manifest in the Bodies of other Animals. Hence it is, that even Monsters themselves are not to be slighted. The Mechanism that is concealed in one Species of Creatures, or in a common Structure, may be disclosed in another Kind, or in an extraordinary Composition ; and one would be
apt

apt to say that Nature by multiplying and diversifying her Works, cannot sometimes avoid discovering her own Secret.

The Ancients knew the *Load-stone*, but they were acquainted with no other Quality of it, save that of *attracting Iron*. Whether it was, that they did not much value a Curiosity which led them to nothing, or whether they had not the Genius of making Experiments, it is certain they did never examine the Nature of this Stone with the Attention that was due to it: One single further Experiment might have taught 'em, that it turns of it self towards the Poles of the World, and had thrown into their Hands the inestimable Treasure of the Sea-Compass. They did in a manner touch the important Discovery and let it go again; and if they had allowed a little more time to a Curiosity which seemed unprofitable, the hidden Advantage would soon have discovered it self.

Let us always be heaping up *Mathematical* and *Physical* Truths, and let what will come of it, the Risque cannot be great: This is certain, that out of such a Stock, a great number have arisen which have been found to be exceeding useful: We may justly presume that we shall draw a great many from the same *Well*, shining even at their Birth with a sensible and undoubted Profit; others there will be, that must stay some time, till they be ripen'd and their Use discover'd by a careful Meditation, or a lucky Chance: There will be others, which, taken singly, may appear barren, and perhaps will not be otherwise till we think of coming near them: Lastly, and at the worst, there may be some also that shall remain for ever useless.

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I mean useless with respect to Sensible and, as I may say, coarse Uses, for otherwise they will not be so. An Object, towards which we turn our Eyes only, becomes more clear and more illustrious when the neighbouring Objects, which we do not however look upon, are enlighten'd as well as it; for it takes advantage of the Light, which they communicate to it by Reflexion. Thus the Discoveries that are visibly useful, and which seem only to deserve our chief Attention, are in some manner illustrated by others that are thought useless. All Truths are enlighten'd by each other.

It is always useful to think right, even upon useless Subjects. Tho' Numbers and Lines should absolutely lead us to nothing; yet they would always be the only certain Sciences that are bestowed upon our Natural Lights, and they would serve to furnish our Reason more surely with the first Habit, and the first Turn towards Truth: They would teach us to work up Truths to catch the first Thread of them, tho' often exceeding fine and almost imperceptible, and to follow it as far as it could lead us; in a word, they would render Truth so familiar to us, that upon other occasions we might discover it with the first cast of the Eye, and, as it were, almost by Instinct.

The Geometrical Genius is not so confined to *Geometry*, but that it may be drawn away from it, and applied to other Sciences. A Work of Morality, of Politicks, of Criticism, perhaps of Eloquence it self, will be more beautiful, all other Things being equal, if it be performed by the Hand of a *Geometrician*. The Order and Regularity, the Method and Exactness, which shine in good Books of late,
may

may be first owing to that Geometrical Spirit, which spreads it self more than ever, and which in some manner draws nearer and nearer, even to those that do not understand Geometry.

Sometimes a Great Man gives the Mode to all those of his own Age; and he to whom the Glory of establishing a new Manner of Reasoning is most justly due, may appear to have been some excellent Geometrician.

Lastly, Every thing that raises us to Reflections, which altho' purely Speculative, are Great and Noble, is an Advantage which may be named Spiritual and Philosophical; for the Mind has its Wants as well as the Body, and they are perhaps of as large an Extent too. It will *know*, and all that can be *known* is necessary to it; and nothing proves more plainly how much it is destined to the finding out Truth; nothing perhaps is more Glorious for it than the Pleasure it tastes, and sometimes, in spite of it self, in the dryest and most thorny Study of *Algebra*.

But without changing the common Idea's of Things, and without having recourse to Advantages that may appear too subtle and too refined, we may positively assert, that both the *Mathematicks* and *Philosophy* have Parts in them which are only curious, and this is common to them, with other Sciences, that are generally allowed to be very useful, such as *History*, &c.

History does not furnish, in its utmost Extent, Examples of Virtue, nor Rules for the Conduct of our Lives: Besides which, it is only a Representation of perpetual Revolutions in Humane Affairs, of the Rise and Fall of Empires, of Manners, Customs,

stoms and Opinions, which are continually succeeding one another; in a word, of all that rapid Motion, which altho' insensible, whirls every thing about with it, and is always changing the Face of the Earth.

If we would set one Curiosity against another, we shall find, that instead of this Motion which tosses about Nations and overturns States, producing others out of their Ruin, *Philosophy* considers the great and universal Motion, by which the whole Course of Nature is put into Order, which has hung up the heavenly Bodies in different Spheres, which kindles and extinguishes the Stars, and which by always following unchangeable Laws, produces an infinite variety of Effects. If the amazing Difference of the Manners and Customs of Nations is so agreeable to be reflected on, it must also be an extremely great Pleasure to consider the vast Diversity in the Composition of the different Kinds of Animals, with respect to their different Functions, to the Elements where they live, to the Climates they inhabit, and to the Food by which they are subsisted. The most curious Stroaks in History can hardly be compared to the *Phosphori*, to *cold Liquors*, which being mingled together, produce *Heat* or *Flame*; to *Trees of Silver*; to the almost *Magical* Sports of the *Load-stone*; and an infinite number of Secrets that Art has discovered, by watching closely, and curiously prying into Nature. In a word, *Philosophy* traces and unravels, as much as possible, the Footsteps of that infinite Wisdom and Understanding which has produced all Things; whereas *History* has only for it Objects the irregular Effects of the Passions and Caprices of Men, and a train of Events so whimsical; that it

was

was formerly supposed, that they were governed and directed by a blind and senseless Divinity.

We must not count among the simple Curiosities of *Natural Philosophy*, those sublime Reflections upon the Author of the Universe, to which it directly leads us. That great Work, always more wonderful in proportion to its being better known, give us so high an Idea of its Author, that we perceive our Minds overwhelmed with Admiration and Respect.

Above all, *Astronomy* and *Anatomy* are the two Sciences which do most sensibly offer to our Thoughts two great Characters of the Creator; the one his *Immensity* by the *Distances*, *Magnitude* and *Number* of *Heavenly Bodies*; the other, his *infinite Wisdom* by the *Mechanism* of *Animals*. Thus true Philosophy is exalted even to a kind of *Theology*.

The different Views of the Mind of Man are almost infinite, and Nature is quite so: So that we may daily expect Discoveries either in *Mathematicks* or *Physicks*, that will procure us new Kinds of Profit or Pleasure. Reckon up all the different Uses that could be made of the *Mathematicks* about a hundred Years ago, none of 'em come near the *Glasses* with which they have furnished us since that Time, and which are a new Organ of Sight, that we durst not have expected from the Hands of Art. How great would have been the Surprize of the Ancients, if any one had told 'em, that their Posterity would one Day, by the help of certain Instruments, have discovered an infinite number of Objects, which they were not capable of seeing; a *Heaven* unknown to them, *Plants* and *Animals* of which they did not so much as expect the Existence?

stence? The Naturalists had already made a great number of Curious Experiments, but the Invention of the *Air-Pump* has within half a Century produced a vast Number more of a quite new Nature, and which by shewing us Bodies in a *Space void of Air*, represents them to us as transported into a World different from our own, in which they experience such Changes as we could have formed no Notion of. Perhaps the excellent *Geometrical* Methods which are invented or brought to Perfection from time to time, will at last shew us the End of *Geometry*, that is to say, the Art of making Discoveries in that Science, which is all; but Philosophy, that contemplates an Object of an unbounded variety and fruitfulness, will always find Observations to make, and Occasions of enriching it self, and will keep the Advantage of being a Study that can never be quite compleated.

So many things that remain still, and which will probably always remain to be known, give a handle to the affected Discouragement of those who do not care to enter among the Thorns of Physicks. And in order to render natural Knowledge contemptible, People often fall into an Admiration of Nature, and maintain that she is incomprehensible. In the mean time Nature is never so wonderful, nor so much esteemed, as when she is best understood: It is true, that that which is known is very little in Comparison of that which remains yet unknown; sometimes even that which we do not know, is just what it seems we ought chiefly to apply our selves to. For instance, we do not know, at least not certainly, why a Stone thrown up into the Air falls back again; but we know very well the

the Cause of the *Rainbow*, why it never exceeds a certain Heighth; why its Breadth is always the same; why when there are two Rainbows at once, the Colours of one are turned up-side down with respect to the other, &c. and yet how much more simple a Phenomenon does the Fall of a Stone from the Air appear, than that of a Rainbow? but however, tho' we do not know all, yet we are not ignorant of all neither; tho' we are ignorant of that which appears to the most simple, yet we understand some of those Things that are of a more complex'd Nature; and if we ought to fear that our Vanity often flatters us with the Hopes of attaining the Knowledge of things that are not made for us, it is no less dangerous, if we suffer our selves sometimes to be perswaded by our Sloth, that we are condemned to a State of greater Ignorance than we really are.

We may be allowed to reckon that the Sciences are but just born, either, because that among the Ancients they were always in a very imperfect Condition, or because their Footsteps have been almost wholly worn out, during the long Darknes of the barbarous Ages; or, lastly, because we were not got into the right way of tracing 'em till within a Century. If we should examine historically the Progress they have already made, in so short a space of Time, in spite of the false Prejudices that they were forced to break thro' on all Sides, and which have long resisted 'em, sometimes even in spite of the strange Obstacles of Authority and Power; in spite of the little Zeal that People have had for Knowledges remote from common Customs; in spite of the small number of Learned Men, who have

have devoted themselves to such Labours, in spite of the weak Motives to engage them therein; we should be astonish'd at the Greatness and Swiftneſs of their Progreſs, ſeeing ſo many new ones produced, as it were, out of nothing, inſomuch that we ſhould carry our Hopes too far perhaps for the time to come.

The more Hopes we have that our Advances will be happy, the more we are obliged to conſider the Sciences, at leaſt that of Natural Philoſophy, as lying at preſent in their Cradle. Wherefore the Buſineſs of the *Academy* is only as yet to make an ample Proviſion of Obſervations and well-attesteſt Facts, which may be one Day the Foundation of a System; for Systematical Philoſophy muſt ſtay till the Experimental furniſhes her with neceſſary Materials, before ſhe proceed to Building.

For ſuch a Collection of Materials, nothing but Societies, and thoſe too encouraged by the Prince, can ſucceed in making and preparing it: Neither the Lights, neither the Cares, nor the Life, nor the Purſe of any Private Man are equal to it. There is required too great a Number of Experiments, and of too many different Kinds, and a too frequent Repetition of the ſame, too great a Variation of the Manner of 'em, and too much Time to be ſpent in them for any one Man whatever. The Cauſe of the leaſt Effect is almoſt always involved in ſo many Folds and Intricacies, that unleſs one unravels them with vaſt care, one muſt not hope that they will diſcloſe themſelves.

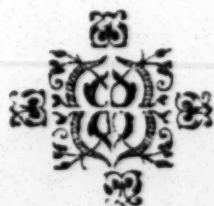
At preſent, the *Academy of Sciences* does not ſet about Nature but in little Parcels: No general System for fear of falling into thoſe raſh ones, which

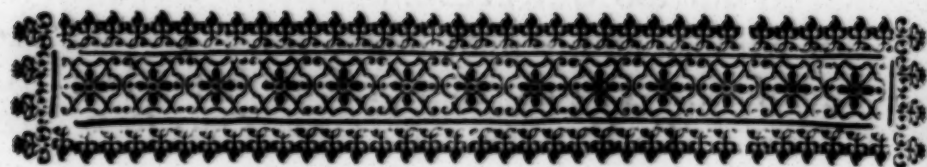
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which do but too well accommodate the Impatience of our Minds, and which being once established do oppose the Truths that present themselves to our View. To Day we make sure of one Fact, to Morrow of another that has no Relation to the former. We venture sometimes to guess at Causes, but then we produce 'em for no more than Conjectures. Thus the Collection which the Academy offers to the Publick, is composed of Pieces that are loose and independent on each other, of which each private Man, who is the Author, is responsible for the Facts and Experiments, and of which the Society does not allow the Conclusions, but with all the Restrictions of a *discreet Scepticism*.

The time will come, perhaps, that these scatter'd Members may be brought into a regular Body, and if they are such as we wish them, they will almost form themselves; several distinct Truths, as soon as they are in a sufficient Number, do so lively offer to the Mind their Relations and mutual Dependencies, that it should seem, that after having been separated from each other, by a kind of Violence, they naturally endeavour to be re-united.





RULES and ORDERS

Appointed by the

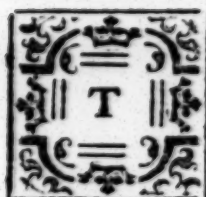
K I N G

F O R T H E

G O V E R N M E N T

O F T H E

Royal Academy of Sciences.



HE King being desirous to give Marks of his Affection to the *Royal Academy of Sciences*, has resolved upon the following Regulations, which his Majesty expects shall be punctually complied with.

I.

THE *Academy* shall always remain under the Protection of the King, and receive his Orders by such of the Secretaries of State, as his Majesty shall appoint to deliver them.

II. T H E

II.

THE said *Academy* shall always be composed of four Sorts of *Academists*, *Honoraries*, *Pensioners*, *Associates* and *Pupils*; the first Class to be composed of Ten Persons, and the three others of Twenty each; and none shall be admitted into any of these four Classes, but by the Choice and Approbation of his Majesty.

III.

THE *Honoraries* shall always be Inhabitants of the Kingdom, and recommendable by their Skill in the *Mathematicks*: One of these shall be *President*; but all of 'em excluded from being *Pensioners*.

IV.

THE *Pensioners* shall always be Inhabitants of *Paris*; three of 'em *Geometricians*, three *Astronomers*, three *Mechanists*, three *Anatomists*, three *Chymists*, three *Botanists*, one *Secretary*, and one *Treasurer*; and when it shall happen that any one of these is called to any Office or Employment, obliging him to live out of *Paris*, his Place shall be filled up by another, in the same manner as if he were Dead.

V.

AMONG the *Associates*, consisting of the like number as the *Pensioners*, Twelve shall always be Inhabitants of the Kingdom, two of whom shall apply themselves to *Geometry*, two to *Astronomy*, two to the *Mechanicks*, two to *Anatomy*, two to *Chymistry*, and two to *Botany*: The eight remaining may be Foreigners, and allowed to apply themselves to such of the above-mentioned Sciences, as shall be most suitable to their Genius and Studies.

VI.

THE *Pupils* shall be such as are settled in *Paris*, and each of them must apply himself to that particular Science of which the *Pensioner-Academist*, under whose Tuition he is put, shall make Profession: And if they should be called to any Employments, requiring them to reside in some other Place, their Offices shall be vacant as if they were Dead.

VII.

To fill the Place of an *Honorary* Member, the Society shall chuse by Plurality of Voices, a Person to be recommended to the King for his Approbation.

VIII.

To fill the Place of a *Pensioner*, three Persons shall be named, of whom two at least are to be *Associates* or *Pupils*, and their Names shall be laid before his Majesty, to the end, that he may chuse one out of 'em.

IX.

To fill the Place of an *Associate*, the *Academy* shall chuse two Persons, one of whom, if not both, to be taken out of the Number of the *Pupils*, and their Names laid before the King, that he may be pleased to chuse one of them.

X.

To fill the Place of a *Pupil*, each of the *Pensioners* may chuse one, whom he shall offer to the Society for their Consideration, and he upon whom the Majority of Voices falls, shall be proposed to his Majesty.

XI.

NO Person shall be proposed to the King, in order to be put into any of the abovementioned Places of *Academist*, unless he be a Man of sound Morals and known Probity.

XII.

NO Man that is a *Regular Ecclesiastick*, or belongs to any Order of Religion, shall be proposed; unless it be to fill the Place of an *Honorary Academist*.

XIII.

NONE shall be proposed to the King, for the Places of *Pensioner* or *Associate*, but such as have distinguish'd themselves by some considerable Work which they have published; by some Course made with Reputation in the Science they profess; by some Machine of their own Invention; or some particular Discovery.

XIV.

NONE shall be proposed for the Places of *Pensioner* or *Associate*, unless they have attained to the Age of 25 Years at least.

XV.

NONE shall be proposed for the Places of *Pupil*, unless they be at least 20 Years old.

XVI.

THE ordinary Meetings of the *Academy* shall be kept in the *King's Library* every *Wednesday* and *Saturday*; but if either of these Days happen to be a Holiday, the Meeting shall be the Day before.

XVII.

EACH Meeting shall last at least two Hours, that is to say, from Three to Five in the Afternoon.

THE Recesses or Vacations of the *Academy* shall begin upon the 18th of *September*, and end the 11th of *November*, besides which there shall be no Meetings during the 15 Days of *Easter*, *Whitson-Week*, and from *Christmas* to *Twelfth-day*.

XIX.

THE *Academists* shall diligently attend at every Meeting; and none of the *Pensioners* be absent above two Months for his own particular Affairs, without his Majesty's express Leave, unless it be in the time of the Vacations.

XX.

IT having been found by Experience, that there are a great many Inconveniencies in these Works to which the *Academists* apply themselves in common; each one shall chuse a particular Object of his Studies, and by the Account he shall give of it in the Meeting; he shall endeavour to enrich the *Academy* by his Discoveries, and improve himself at the same time by their Observations.

XXI.

AT the beginning of each Year, every *Pensioner* *Academist* shall be obliged to give an Account in Writing to the rest of the Body, what Work he designs chiefly to engage in; and the other *Academists* shall be desired to give the like Declarations of their Designs.

XXII.

THO' each *Academist* be obliged to apply himself chiefly to such things as relate to the particular Science in which he is engaged; yet every one shall be exhorted to extend his Enquiries into all that may be useful and curious in the several Parts
of

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of the *Mathematicks*, in the different Course of Arts, or that may any way relate to the Knowledge of *Natural History* and *Philosophy*.

XXIII.

AT every Meeting, two at least of the *Pensioners Academists*, shall be obliged, in their turns, to bring some of their particular Observations; as for the *Associates*, they shall always have the Liberty to propose theirs likewise; and all that are present, whether *Honorary Pensioners*, or *Associates*, may, according to the Order of their Science, make their Remarks upon what has been proposed; but the *Pupils* shall only speak when they are desired by the *President*.

XXIV.

ALL the Observations brought by the *Academists* to the Meetings, shall be by them, the same Day, delivered in Writing to the *Secretary*, to the End, that Recourse may be had to them upon occasion.

XXV.

ALL the *Experiments* that shall be related by any *Academist*, shall be repeated by him, if possible, at the Meeting, or at least at Home in private, when some of the *Academists* are present.

XXVI.

THE *Academy* shall take great care, that upon all occasions, when the Members happen to be of different Opinions, no Expressions of Anger or Contempt be used by them against each other, neither in Discourse nor Writing: and whenever they happen to oppose the Sentiments of any Learned Men whatever, they shall be exhorted to speak of him with Respect.

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XXVII.

THE *Academy* shall take care to maintain a Correspondence with all the Learned Men, either in *Paris*, or other Provinces of this Kingdom, or even in foreign Countries, to the end, that they may be readily informed of all that passes, either in *Mathematicks* or *Physicks*; and when they come to fill up the Vacancies of Members, Preference is given to those Learned Men who have been most punctual in such kind of Correspondencies.

XXVIII.

THE *Academy* shall appoint some of their Members to read all the valuable Pieces that appear in *Physicks* or *Mathematicks*, whether in *France* or elsewhere; and the Person to whom any such Pieces is referr'd, shall make his Report to the Company without Criticising upon it, and only represent what may be useful in it.

XXIX.

THE *Academy* shall repeat all the considerable Experiments that have been made elsewhere, and shall note upon their Books the Conformity or Difference between their own, and others Observations.

XXX.

IF any of the Members propose to Print a Book, it shall be first submitted to the Examination of the *Academy*; and no Approbation of it shall be given, till it has been quite read in the Publick Meetings, or at least not till after an Examination and Report of it has been made by such Persons to whom it shall have been referr'd: And none of the Members shall put his Title of *Academist* at the Head
of

of any Work which he Publishes, unless it has been thus first approved by the *Academy*.

XXXI.

THE *Academy* shall examine, if his Majesty orders it, all the *Machines* for which his Patent or Priviledge is desired by the Inventors, and shall certify whether they be New and Useful; and the Inventors of such as have been approved shall be obliged to leave a Model with the *Academy*.

XXXII.

THE *Honorary Pensioners* and *Associates Academists*, shall have Voices when the Debate is only about Sciences.

XXXIII.

THE *Honorary* and *Pensioner Academists* shall have Voices in all Elections, and other Affairs relating to the Society, and all shall be determined by Balotting.

XXXIV.

SUCH as are not of the *Academy* may not assist, nor be admitted into the Ordinary Meetings, unless it be when they are introduced by the *Secretary*, in order to propose some New *Machine*, or other Discovery.

XXXV.

EVERY Body shall be admitted into the Public Meetings, which are to be held twice a Year, the first the Day after St. *Martins*, and the other the Day after *Easter*.

XXXVI.

THE *President* and the *Honorary Members* shall sit at the upper end of the Table: The *Pensioners* on each side of the Table, the *Associates* at the lower
End

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end, and the *Pupils* each one behind the *Academist*
to whom he belongs.

XXXVII.

IT shall be the care of the *President*, that good Order be kept at every Meeting ; and he shall give an exact Account to the King, or to that Secretary of State, to whom his Majesty shall refer him, of all Matters relating to the *Academy*.

XXXVIII.

IN all Meetings, the *President* shall cause the different Matters to be fairly Debated, take the Opinion of every one that has a right of Voting according to their Order, and shall determine the Question by the Plurality of Voices.

XXXIX.

THE King shall appoint a *President* the first Day of every Year ; but tho' a new Nomination be necessary each Year, yet he may be continued during his Majesty's Pleasure ; and whereas the said *President* may be obliged to be absent sometimes, either thro' Indisposition, or on account of his private Affairs, the King will be pleased at the same time to appoint another *Academist*, who shall supply the *President's* Absence.

XL.

THE *Secretary* shall be very punctual in Collecting the Substance of all that is proposed, debated, examined and resolved in the Meetings, and shall enter an Account of it in the Journal of each Day, and register the Books or Papers that have been read : He shall Sign all the Accounts that shall be given thereof, either to the Members of the Society, or to any others that may be concerned to have them ; and every Year at the end
of

of December, he shall publish an Extract from his *Registers*, or a *Rational History* of the most remarkable *Transactions* of the Society.

XL I.

THE *Registers*, *Titles* and *Papers* concerning the *Academy*, shall always remain in the Hands of the *Secretary*, to whom they shall be deliver'd by an Inventory, which the *President* shall make of them : And at the end of every Year, the said Inventory shall be collated by the *President*, and augmented with every thing that has been brought in, during the said Year.

XL II.

THE *Secretary* shall be perpetual, and when thro' Sickness, or any other just Cause, he be hindered from attending, he may appoint such of the *Academists* as he thinks fit, to take the Minutes in his stead.

XL III.

THE *Treasurer* shall keep all the *Goods*, *Books*, *Instruments*, *Machines*, and other *curious* Things belonging to the *Academy*; and when he enters upon his Office, the *President* shall deliver them all to him by an Inventory; and at the end of every Year, he shall insert into the said Inventory all that has been added since the last Year.

XL IV.

WHEN any Learned Man shall desire to see any of the Things committed to the Custody of the *Treasurer*, he shall take care to shew them; but he shall permit nothing to be taken from the Place where it is kept, without an Order in Writing from the *Academy*.

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XLV.

THE *Treasurer* shall be perpetual, and when thro' any Lawful Impediment he cannot fulfil the Duties of his Place, he may substitute some *Academist* during his Absence.

XLVI.

TO facilitate the Impression of the several Works that may be composed by the *Academists*, the King allows them to chuse a *Bookseller*, to whom, in Consequence of such Choice, his Majesty will grant the necessary Priviledges for Printing and Dispersing the Works of any Member as soon as they shall be approved of by the *Academy*.

XLVII.

FOR encouraging the *Academists* to continue their Labours, his Majesty will continue to pay them their Ordinary Pensions; and will moreover grant them extraordinary Gratifications, in proportion to the Merit of their Works.

XLVIII.

FOR the Assistance of the *Academists* in their Studies, and to facilitate the Means of perfecting their respective Sciences, the King will continue to allow the necessary Charges for making the several *Experiments* and *Discoveries* of every *Academist*.

XLIX.

To recompence the diligent Attendance of Members, at the Meeting of the *Academy*, the King will distribute at every Meeting forty *Jettons* to all the Pensioners as shall be then present.

L.

IT is his Majesty's Pleasure, that the present Regulation be read at the next Meeting, and entered

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tered into the Books, to the End, that it may be punctually observed according to the Form and Tenor thereof; and if any of the Members neglect or refuse to comply therewith, the King will cause him to be punished according to the Nature of the Case.

Done at Versailles, 26. Jan. 1699.

Signed *LEWIS.*

And lower, *Phelypeaux.*

By Vertue of this Regulation, the *Academy of Sciences* became a Corporation, established by Royal Authority.

It is a very numerous Body, including under different Titles the most famous Persons in any of the Sciences, and even such as are like to become so.

Among them are to be found, not only the most Learned in all the Provinces of *France*, but also those of other Countries.

The *Academy* is continually recruited from within it self; and those who may in time become the Principal Members, may begin early to form themselves for it.

At the same time there is always room for Strangers of Merit.

The *Academy* has Correspondents in all Places where there are Sciences, and draws to it self the first News, and the first Fruits of most of the Discoveries that are made Abroad.

The

The different Methods of coming into this Body are proportioned to the different Views of those who desire to come in, and to the different Classes of the *Academists*.

By these Regulations, the Members are engaged more strongly than ever to their respective Labours, and even to great Diligence therein.

The *Academy* does also become hereby much more known to the Publick, as well as the Business in which it is engaged, and the Taste, the Fruit and the Spirit of Sciences may be much more easily communicated Abroad.

After that the Regulations had been read in the Assembly, the *Abbot Bignon* communicated the following LETTER from Monsieur de *Pontchartrain* to him the said Abbot.

SIR,

IN Consequence of the Regulations made by the King, the Twenty sixth Instant, for the Royal Academy of Sciences, I have laid before his Majesty a List of the Members, who at present compose that Body, viz. you yourself, Sir, the Marquis de L'Hopital, the Father Truchet, Captain Renau, Mons. de Mallezieu, Father Malebranche, and Father Gouye, Honorary Academists: Abbot Gallois, the *Sieur Rolle* and the *Sieur Varignon*, Geometricians; the *Sieurs Cassini*, de la Hire and Le Fevre, Astronomers; the *Sieurs Filleau des Billets*, Jaugeon and Dalesme, Mechanists; the *Sieurs du Hamel*, du Verney and Mery, Anatomists; the *Sieurs Bourdelin*, Homberg, and Boulduc, Chymists; the *Sieurs Dodart*, Marchand, and Tournefort, Botanists; the *Sieur de Fontenelle*, Secretary; the *Sieur Couplet*, Treasurer; and

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and Pensioners; the Sieurs Liebnitz, Tschirnaus, and Guillelmini, Foreigners; the Sieurs Maraldi and Regis, Geometricians; the Sieurs Cassini the Son, and de la Hire the Son, Astronomers; the Sieurs Chazelles, and de Lagny, Mechanists; the Sieurs Tavry, and Bourdelin the Son, Anatomists; the Sieurs de Langlade and Lemery, Chymists; the Sieurs Maurin de St. Victor, and Maurin Toulon, Botanists and Associates: Under the Sieur Varignon, the Sieur Carreé, Pupil; under the Sieur Cassini, Astronomer, the Sieur Monty, Pupil; under the Sieur Homberg, the Sieur Geofroy, Pupil; under the Sieur Couplet, his Son, Pupil. His Majesty was pleased to shew his particular Satisfaction of the Merit and Diligence of each of the above-mentioned Gentlemen, and does approve of and confirm them in their respective Places: But you must observe, that the Sieur Dodart is approved of for a particular reason, for, his Employment of Physician to the Princess of Conti, obliging him to live with that Princess out of Paris, according to the fourth Rule, he would be excluded from the Number of the Pensioners; nor would the King continue him in it, but for the reason above-mentioned, and for his long standing in the Academy, but this shall not be made a Precedent. The King has moreover commanded me to let you know, that you should immediately proceed to the Election of Persons fit for the Places that remain to be filled, according to the aforesaid Regulations.

I am Sir,

Your most Affectionate,

And most Humble Servant,

*Versailles the
28th, Jan. 1699.*

Pontchartrain.

As by this Letter, the King appointed several New Members ; there was a very agreeable Confusion (to which we were not accustomed) at the following Meeting : For both the Old Members, some of whom had not been very exact in their Attendance, failed not to be present ; and all the New Ones did likewise take Possession of their Places, which made a great Appearance in one of the smallest Chambers of the King's Library. But this Disorder was quickly at an end, the Abbot *Bignon* having ranged all of them in their proper Places, by which means the learned Men of different Kinds, a *Geometrician*, for Example, and an *Anatomist* were set next each other ; and as those Gentlemen do not speak the same Language, there was no danger of interrupting the Publick Business by Private Conversations.

At this Meeting, which was the first of the New *Academy* ; the first thing consider'd, was, the Obligations we lay under to *Monf. Pontchartrain*. It was unanimously resolved that we should go in a Body, with the Abbot *Bignon* at the Head of us, to give him our most humble Thanks for the Establishment he had been so kind to obtain of the King for us, and to desire the Continuation of his Protection.

The *Academy* also appointed a Committee to wait upon the Abbot *Bignon*, their *President*, with their Acknowledgments for the share he had had in their Establishment.

After which several Meetings were wholly spent in putting us into that Posture which was required by our New Regulation.

They

They began by filling up the vacant Places of the *Honorary* and *Associate Academists*, and of their *Pupils*, pursuant to their new Rules and Orders. The new *Honorary* Members proposed by the *Academy*, and afterwards approved by the King, were, according to the Order of Time, the following Gentlemen : Monsieur *Fagon* the first *Physician* to His Majesty, the Abbot *de Louvois*, and Monsieur *de Vauban*.

The new *Associates*, according to the same Order, were Monsieur *Hartsoeker*, Messieurs *Bernoulli*, Brothers, Monsieur *Newton* and Monsieur *Viviani*, Foreigners; the new *Pupils* were Monsieur *Burlet*, Doctor of *Physick*, under Monsieur *Dodart*; Monsieur *Berger*, Batchelor of *Physick*, under Monsieur *Tournefort*; Monsieur *Boulduc* the Son under his *Father*; Monsieur *Tuillier*, Batchelor of *Physick*, under Monsieur *Bourdelin*; Monsieur *Chevalier* under the Abbot *Gallou*; Monsieur *Littre*, Dr. of *Physick*, under Monsieur *Dubamel*; Monsieur *Poupart* under Monsieur *Mery*; Monsieur *Simon de Valbebert* under Monsieur *Fontenelle* the Secretary; Monsieur *Parent* under Monsieur *des Billettes*; Monsieur *de Senne* under Monsieur *Faugeon*; Monsieur *Reneaume*, Batchelor of *Physick*, under Monsieur *Marchand*; Monsieur *Amontons* under Monsieur *le Fevre*; Monsieur *Du Torrar* under Monsieur *Rolle*; Monsieur *Lieutaud* under Monsieur *de la Hire*; Monsieur *du Verney* under his Brother; and Monsieur *de Beauvilliers* under Monsieur *Dalesme*; Monsieur *Sauveur*, who has been many Years in the *Academy*, was continued in the same, under the Character of a Veteran.

They next consider'd about a *Seal* and a *Device* for the Company.

The *Seal* was a *Sun*, the Emblem of the King and of the Sciences, between Three *Fleur de Lys*; and the *Device* was a *Minerva*, encompassed with the Instruments of the Sciences and Arts, with this Latin Motto, *Invenit & Perficit*.

But among all these Preliminary Meetings, the most considerable was that, in which all the *Pensioner Academists* gave an account in Writing of the Works in which they were engaged, and when they hoped to finish them. This was a kind of a Vow which they made at this new Birth of the Society; and the greatest Part of the *Associates* and *Pupils* did the same, tho' they were not obliged to it. Some of those *Academists* have already discharged their Promise, and their Works have appeared in Publick.

All the Members present did likewise name the several Persons with whom they should enter into a Correspondence upon the Business of Sciences, whether in *France* or in Foreign Countries; and the *Secretary*, in the Name of the *Academy*, dispatched Letters to all these Correspondents, desiring them to maintain a regular Commerce with the respective Members.

It was easie to observe that these Preliminaries, tho' unavoidable, appeared heavy to the Company, which was impatient to enter upon serious Business, at which at last it arrived, and from that time its *History* takes notice of nothing else, but *Observations* and *Discourses* proposed in the Meetings.

But

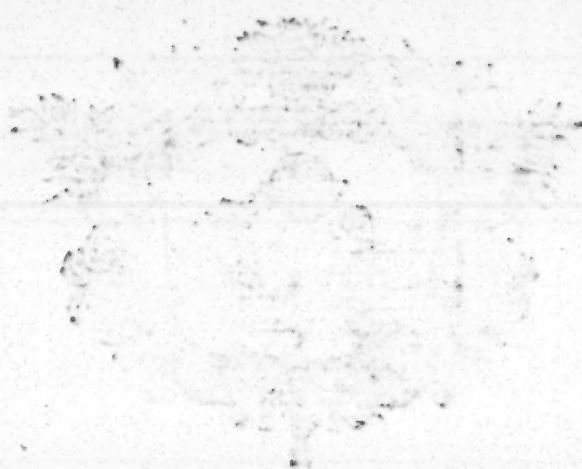
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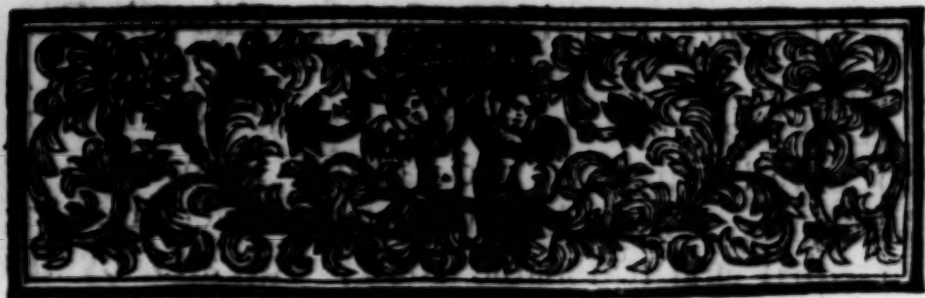
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But we must not pass by one Fact which Gratitude and even the Glory of the *Academy* renders absolutely necessary to be mentioned in our History, and this is a new Favour bestowed upon us by his Majesty, who instead of the little and close Chamber in his Library, has given us a spacious and magnificent Apartment in the *Louvre*; and the first Meeting after *Easter*, which according to the Regulations made in *February* 1699. was to be Publick, was held in the said new Apartment.



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THE
L I V E S
OF THE

French Philosophers,

Late MEMBERS of the *Royal
Academy of Sciences.*

PART I.

The LIFE of Monsieur BOURDELIN.



Claudius Bourdelin, was born in the Year 1621, at a Place called *Villa Franca*, near *Lyons*; he lost both Father and Mother whilst he was very Young, and was brought to *Paris*. Being left in a dangerous Age and Country, he applied himself, of his own accord, to the Study

2 *The Life of Monsieur* **BOARDELIN.**

of *Greek* and *Latin*, with a design to learn *Physick* and *Chymistry*, which have since been his only Employment during the space of above 56 Years.

In a small time he acquired a great Reputation, not only by his exact and faithful Preparation of Medicines, which he distributed to every Body at an equal and reasonable Rate; but also by his Knowledge of Distempers, upon which, without any Fee, he gave modest and, very often, happy Advice, tho' he never positively assured any of his Patients that they should recover; People put a very great Trust in him. He did not approve of Bleeding excepting in the *Apoplexy*; and we have seen him cure, without that Method, a great number of acute and inflammatory Distempers, such as *Pluresies*, the *Defluxions* on the Breast, *Quinsies*, &c.

When the *Royal Academy of Sciences* was set up by *Monf. Colbert*, in the Year 1666, who applied all his Care to chuse proper Members, *Monf. Bourdelin* was adopted into their Number, under the Character of *Chymist*, and he presently applied himself, in Conjunction with *Monf. Du Clos*, to enquire into the Mineral-Waters of the Kingdom. He afterwards made a great number of Experiments upon the Mixture of Juices of Plants, or Spirits and Salts of Minerals, with Arterial or Venous Blood, or with the *Bile*, *Gall* and *Lymph* of Animals. He traced the Analysis of all the Plants he could procure with the utmost Diligence and Exactness, and has very much contributed to the Perfection of that Method, which the Academy had a mind to pursue as far as they could. He likewise attempted the Analysis of Oyls, by the means of his

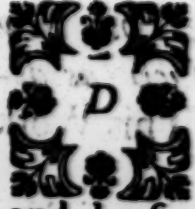
The Life of Monsieur TAUVRY. 3

his Invention, which has discover'd, in a great measure, the Nature of that kind of mixed Bodies. In a word, he has shewn the Society near 2000 Analyses of all sorts of Bodies, and has either executed or invented the greatest part of the Chymical Operations that have been made in that Society for more than thirty Years.

He died the 15. October. 1699. being aged about fourscore Years, and met Death with all the Constancy of a Philosopher, and a good Man.

He left two Sons, both of them Academicians, one of 'em Member of the *Academy of Sciences*, the other of that of *Inscriptions*: His Place of *Pensionary Chymist* has been filled by Monsieur Lemery, who was his Associate.

The LIFE of Monsieur TAUVRY.

 *Aniel Tauvry*, born in the Year 1669. was the Son of *Ambrose Tauvry*, a Physician of the Town of *Laval*. His Father taught him Latin and Philosophy, and he found in him such happy Dispositions towards Learning, that he made him dispute publickly upon a Thesis in *Logick* at the Age of Nine Years and a half, and about a Year after, upon another General and Problematical Thesis in *Philosophy*. Afterwards Monsieur *Tauvry*, the Father, who was Physician of the Hospital of *Laval*, taught his Son at the same time both the Theory of Physick, and the Practice also, upon the diseased Persons in the said Hospital. But to the End that he

4 *The Life of Monsieur TAUVRY.*

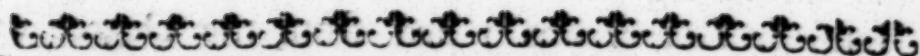
might be yet better instructed in that Profession, he sent him to *Paris*, as soon as he was 13 Years old ; and two Years after the Young Man was made Doctor of Physick in the University of *Angers* : During the three first Years after he had taken his Degree he set himself close to the Study of *Anatomy* ; and at the Age of Eighteen, published a Book called *Rational Anatomy*. I cannot forbear giving you the exact Periods of the Studies of so hopeful a young Man : From *Anatomy* he passed on to the Knowledge of Medicines, and composed his Treatise of *Medicaments* when he was but 21 Years Old. Some time after, upon the King's forbidding Foreign Physicians to practise, he presented himself to the Faculty of *Paris*, and was by them admitted *ad eundem* : He doubled his Diligence in a Profession which he had embraced, as it were from the Cradle ; and as his Mind was fruitful in Reflections, and that his Reading and Experience continually furnished him with Matter, he published another Book, intituled, *The New Practice in acute Distempers, and all such as depend on the Fermentation of Liquors*. This Work appeared in 1678.

I knew him about that Time, and conceiv'd a great Esteem for him ; I had the Honour to be a Member of the Academy, and a Right to name a *Pupil* ; I thought I could not make a better Present to the Society, than that of *Monf. Tauvry* ; and tho' my Nomination did not do him so much Honour as he deserved, yet his desire of being admitted into such an illustrious Body, made him wave that Scruple.

In 1699, the King honoured the Academy with a new Regulation, making several new Members,
and

The Life of Monsieur TAUVRY. 5

and advancing the old ones. 'Twas then that Monsieur *Tauvry* was raised from the Degree of *Pupil* to that of *Associate*. Soon after he engaged against Monsieur *Mery*, in the famous Dispute of the *Circulation* of the *Blood* in the *Fœtus*, and upon that occasion published his *Treatise of the Generation and Nourishment of the Fœtus* in 1700. This Dispute occasioned perhaps the Distemper of which he died; for as his Adversary was a great Man, he labour'd very hard, and robb'd himself of a great part of his Rest to penetrate into the bottom of the Matter in Question, and in the mean time continued the Practice of his Profession. However it was, his Natural Disposition to an *Asthma* increased towards the Beginning of the Year 1701. He died of the *Phthisick* in the Month of *February*, aged 31 Years and a half. It appears sufficiently by what has been said of him, that he had a great Vivacity and Penetration of Mind. To the great Skill he had in *Anatomy*, he joyned the Talent of happily guessing at the Use of Structures, and in general he had the Gift of framing Systems. It is very likely that he would have shined in the Practice of Physick, tho' he had neither Patrons, Clubs, nor Art to set himself out; his Merit began already to procure him an Admittance into several considerable Families, by which I know his Loss has been much lamented. His Place of *Associate* has been filled by Monsieur *Littre*, who was before the *Pupil* of Monsieur *Dubamel*.



The LIFE of Monsieur TUILLIER.

T*h***O***n***A***n***W***h***O** *Drian Tuillier*, Son of Monsieur *Tuillier*, Regent Doctor of the Faculty of Physick at *Paris*, born 18. *Jan.* 1674. was at first designed for the Study of the Law, and began to distinguish himself therein at the Age of 22 Years; but his natural Inclination for Physick, soon induced him to abandon the Practice of the former; he applied himself therefore to the latter; and at the Age of 26. was admitted Regent Doctor with great applause.

He came into the Academy in the Year 1699. in the Quality of *Pupil* to Monsieur *Bourdelin*; and as Monsieur *Lemery* succeeded Monsieur *Bourdelin* in the Office of *Stipendiary Academist*, Monsieur *Tuillier* became his *Pupil* also.

In 1702. He was appointed Physician of the Hospital of *Keyserwert*, and as the Siege of that place lasted a great while, by the vigorous Defence of the Marquis *de Blainville*, its Governour, Monsr. *Tuillier* had so many Sick and Wounded under his Care, that the Fatigue and Trouble thereof threw him into a continued malignant Fever, of which he died *June* 2. in the same Year.

His Place of *Pupil* to Monsr. *Lemery* was naturally filled by Monsr. *Lemery* the Son, who had been before the *Pupil* of Monsr. *Tournefort*.

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The LIFE of Monsieur VIVIANI.

I*ncentius Viviani*, a Gentleman of *Florence*, was born in that City the 5th of April, 1622. at the Age of 16 Years he learn'd Logick, and his Preceptor, who was a Monk, told him that the best Logick was *Geometry*: And as the good Geometricians (who at this Day are not very common) were very rare at that Time, in all *Tuscany* there was but one Master of the *Mathematicks*, who was also of a Religious Order, and under him Monsieur *Viviani* began his Study.

The great *Galileo* was at that Time very aged; and, according to his own Expression, had lost those Eyes, by which he had discovered a New World. He had not however forsaken his Studies; neither his Inclination, nor his surprising Success; would suffer him to leave off: He therefore made use of some young People, who served him instead of Eyes, and whom he had the Pleasure to Form. Monsieur *Viviani* had hardly studied Geometry a Year, when he became fit to be taken in by *Galileo*, and as it were, to be adopted by him; which happen'd in the Year 1639.

About 3 Years after he likewise took into his Family the famous *Evangelista Torricelli*, and died about three Months after, at the Age of 77 Years; a rare Genius, and whose Name we shall always see at the Head of some of the most important Discoveries upon which our Modern Philosophy is founded.

Monf.

8 *The Life of Monsieur VIVIANI.*

Monsieur *Viviani* had then lived three Years with *Galileo*, that is to say, from 17 to 20. being happily born for the Sciences, and full of that vigour of Mind which Youth produces, it is not strange he profited extreamly by the Lessons of so excellent a Master; but it is much more so, that notwithstanding the great Disproportion of their Age, he had conceived a passionate Friendship, and lively Tenderneſs for his Master *Galileo*: He calls himself, every where, the Scholar, and the last Scholar too, of the great *Galileo*, for he has long survived his Colleague *Torricelli*: He never put his Name to any of his Works, but with that Character, and always took an occasion to mention his great Master, and sometimes even, (which shews the Sincerity of his Heart) without any Necessity: He never named the Name of *Galileo*, without paying Homage to it; and one may easily perceive that he did not do it with any Design of equaling himself to that great Person, or to derive any part of his Merit upon himself; the Stile of *Tenderneſs* is easily distinguishable from that of *Vanity*.

After the Death of *Galileo* he spent two or three Years in the Study of Geometry, without any Interruption, and it was then that he formed the Design of his *Divination upon Aristeus*. To explain the Meaning of that Divination, we must trace a little back the History of the Ancient Geometricians.

Pappus of *Alexandria*, a Mathematician in the Time of *Theodosius*, mentions in some places an *Aristeus*, whom he calls the Elder, to distinguish him from another *Aristeus*, who was likewise a Geometrician, but lived after him: *Aristeus* the Elder had composed five Books of *the Solid Places*, that is to say, accord-
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ing to the Explanation of *Pappus* himself, of the three *Conic Sections*. He could not be later than *Euclide*, whose *Elements* we have, and consequently he lived about 300 Years before *Jesus Christ*; those five Books are quite lost.

Monsieur Viviani being very well versed in the Geometry of the Ancients, and regretting the Loss of a great number of their Works, undertook, when he was but 24 Years old, to repair it, at least in part, by following, as far as it was possible, their Track, and endeavouring to guess at what they should have told us. If it be ever permitted to Men to divine, it is upon this occasion, in which, if one be not sure to find just what one looks for, one is at least sure of finding nothing to the contrary, and of always meeting with an Equivalent.

Whilst *Monsieur Viviani* was at work to draw out of his own Stock the five Books of *Aristeus*, upon the *Solid Places, or Conic Sections*, he was crossed by a great number of different Affairs, such as Domestic Cares, Sickneses, and Publick Works, in which he was employed by the Princes of the House of *Medicis*, by whom his Merit was already found out, and also rewarded.

He was fifteen Years together without being able to enjoy that Tranquility which is so necessary for deep Studies; in the mean time, that of *Geometry*, which does not use to let People rest, when she has once taken Possession of them, pursued him in the midst of his various Avocations; and he devoted to her all the Moments he had to breath in, and then conceived the Project of a Work in which he should have occasion for guessing again.

Apollonius

Apollonius Pergæus, so called from a City of *Pamphylia*, and who lived about 250 Years before *Jesus Christ*, had collected all that had been writ about *Conic Sections* before his Time by *Aristeus*, *Eudoxus* of *Cnida*, *Menæchmus*, *Euclides*, *Jonon*, *Thrasidius* and *Nicoteles*, 'twas he who first gave the Names of *Parabolon*, *Hyperbolon* and *Ellipsis* to the Three *Conic Sections*, which do not only distinguish, but describe them too. He had composed eight Books, which came down entire to the Time of *Pappus* of *Alexandria*. *Pappus* made a kind of Introduction to that Work; and gave the necessary *Lemma's* for the Understanding of it. Since then the Four last Books of *Apollonius* are lost.

It appears by the Epistle of *Apollonius* to *Eudemus*, and by *Eutocius* the *Ascalonite*, a younger Author than *Pappus*, that in the Five Books of the *Conics* of *Apollonius*, he treated of the greatest and the smallest Right Lines, which we call at present, the Questions *de Maximis & Minimis*.

Monsieur *Viviani* leaving *Aristeus* for a while, turned his Thoughts to the restoring, after the same manner, the Fifth Book of *Apollonius*, and employed himself therein during the fifteen Years of his several Distractions.

In the Year 1658, the famous *John Alphonsus Borelli*, Author of the excellent Book, *De Motu Animalium*, passing thro' *Florence*, found in the great Duke's Library an Arabick Manuscript with this Latin Inscription, *Apollonii Pergæi Conicorum Libri Octo*. He judged by all the external Marks he could discover, that this was effectively the Eight entire Books of *Apollonius*; and the Great Duke
allowed

allowed him to carry the Manuscript to Rome, that it might be translated by *Abraham Ecchaelensis* the Maronite, Professor of the Oriental Languages.

Thereupon Monsieur *Viviani* who was unwilling to lose the Fruit of what he had collected for his Conjectures upon the Fifth Book of *Apollonius*, took all the necessary Measures to convince the World, that all that he had done was only Guess-work : He procured authentick Testimonials that he did not understand Arabick, and for greater Proof, that he had never seen the Manuscript : He prevailed with Prince *Leopold*, Brother to the Great Duke *Ferdinand* the Second, to mark with his own Hand his Papers in the Condition they were then in ; nay, he would not so much as suffer Monsieur *Borelli* to send him any Account of what *Ecchaelensis* might have discover'd in translating the Manuscript ; in fine, he hurried on his Conjectures, and in the Year 1659. published them under the following Title, *De Maximis & Minimis Geometrica Divinatio in quintum Conicorum Apollonii Pergæi adhuc desideratum*. This was the first Work he published. In the mean time *Abraham Ecchaelensis*, who understood nothing of *Geometry*, assisted by *Borelli*, a great Mathematician, but who knew as little of Arabick, labour'd in the Translation of the aforesaid Manuscript of *Apollonius*. He found that it had been done by an Author named *Abelphath*, who lived at the end of the Tenth Century, and that the whole Eighth Book of it was wanting.

In 1661, *Ecchaelensis* published his Translation of the Fifth, Sixth and Seventh Books. Then it
was

was that the Learned compared *Monf. Viviani's* Conjectures with the Truth, and it appear'd that he had much more than conjectur'd, that is to say, that he had gone a great way farther than *Apollonius* himself upon the same Matter.

After so singular and happy an Incident, he was engaged in a Business of a quite different kind, in which however his Destiny^t put him upon continuing the Works of the Ancients. *Tacitus* relates in the First Book of his Annals, that after the Overflowing of the River *Tiber*, which had done great Damage to *Rome* in the Reign of *Tiberius*, the Senate sought for Means to prevent the like Inconvenience for the Future; that which most naturally occurred, was to turn away the Rivers and Lakes that fell into the *Tiber*. But among all the Rivers the most easie to be turned was the *Clanis*, now called *La Chianad*; for among the Mountains of *Tuscany*, there is a great Lake in a long Plain which the *Chiana* runs thro', and where its Waters have such an *Equilibrium*, that they have no more Inclination of descending Eastwards into the *Tiber* than Westward into the *Arno*, which passes to *Florence*, so that the Waters run both Ways. This River contributes very much to the Inundations both of the *Tiber* and the *Arno*: Wherefore, if it were turned quite into the *Arno*, one of the Causes of the *Tiber's* Inundations might be removed, but it would have been Saving *Rome* at the Expence of *Florence*; insomuch, that altho' this latter City was in those Days no more than an inconsiderable Colony, yet it made such lively Remonstrances to the Senate about it, as prevented the Undertaking. The Inhabitants of
some

some other Cities of *Italy* threaten'd with the same Evil, petition'd likewise against it, representing the Diminution of the Glory of the *Tiber*, which would thereby have fewer Tributary Rivers, and the Respect due to the Bounds formed by Nature, and the Destruction of the Religion of several Nations, who would be deprived of their Gods by being robbed of their Rivers. The *Romans* therefore weighing all these Objections, resolved to leave the Matter as it was; but they did since raise a great Wall, which shut up from one Mountain to the other the Valley thro' which the *Chiana* passed to discharge it self into the *Tiber*, leaving in the middle of the said Wall an Opening or Sluice to regulate the Quantity of Water they would receive. This Wall is to be seen still.

The Disputes about the Course of the *Chiana* were renewed between *Rome* and *Florence* under the Pontificate of *Alexander* the Seventh, and the Pope and Great Duke appointed Commissioners to consider of this Matter; those on the Pope's Side were the Cardinal *Capagna* and Monsieur *Cassini*, who was to be his Assistant, the same that is now a Member of the *Academy of Sciences*. Those whom the Great Duke named, were the Senator *Michelozzi* and Monsieur *Viviani*; so that the *Politicks* had then an indispensable occasion for the Assistance of the *Mathematicks*.

In the Years 1664, and 1665, these Commissioners agreed upon not only what was to be performed on each Side, but also the manner of executing it. But as it often happens in Things that concern the Publick only, they went no farther than the bare projecting them.

14. *The Life of Monsieur VIVIANI.*

This Regulation of the Rivers of *Tuscany* was not a sufficient Employment for two such Men as Messieurs *Cassini* and *Viviani*, they made at the same time some Philosophical Observations upon the *Insects* that are found in the *Galls* and *Knots* of *Oaks*, upon *Shell-Fishes* of the *Sea*, which they dug out of the Mountains of that Country, partly petrified, and partly in their natural State; they even extended their Curiosity to the Antiquities, which the Observers of Nature being sufficiently employed otherwise, look upon sometimes with Contempt, as the too uncertain and casual Effects of the fancy of Men, and they took out of the Earth a great many *Funeral Urns* and *Hetruscan Inscriptions*.

But that which was most considerable was, that in that same place Monsieur *Cassini* shewed Monsieur *Viviani* the Eclipses of the *Sun* in *Jupiter*, caused by the *Satellites* or *Moons* of that Planet, and made Tables or Ephemerides of them.

The Disciple of *Galileo* had the Satisfaction of seeing the Progress that was made by following the Steps of his Master.

About this time something happen'd to Monsieur *Viviani*, which ought to have made him more Proud than any other Incident of his whole Life; for in the Year 1664, the King of *France* settled a Pension upon him, tho' he was not his Subject, nor serviceable to that Prince. If these Circumstances exalt the Merit of Monsieur *Viviani*, they do not less prove the Magnificence of the King, and his Esteem for Learned Men. Monsieur *Viviani* thereupon resolved to Dedicate to the King the Treatise he had formerly projected upon the
solid

solid Places of Aristeus, towards which, what he had already done upon *Apolonius*, gave him great Assistance. To a Man of his Character, the quick Dispatch of that old Design became a Duty. Nevertheless, he was unavoidably hinder'd by some Publick Works, and even by some Negotiations, wherewith the Prince, his Master, had intrusted him. In 1666, he was honour'd by the Great Duke *Ferdinand* the Second with the Title of First Mathematician to his Highness, which was the more Glorious to him, because *Galileo* had worn it before. In 1673, he began to Print his *Aristeus*; but Publick Works, and Infirmities besides, cross'd him again, and made him leave off the Impression.

The following Year produced a new Interruption, from which it was not possible for him to defend himself: The Memory of the great *Galileo* was concerned, some of his Posthumous Writings having been found, and particularly a *Treatise of the Proportions*, to clear the Fifth Book of *Euclide*, who does not seem to have explained himself intelligibly enough upon that Subject. Monsieur *Viviani* printed it in a small Volume in *Quarto*, under the Title of *Quinto Libro degli Elementi d'Euclide, overo Scienza universale delle Proporzioni, Spiegata colla dottrina del Galileo*, 1674. This Work of Geometry is chiefly considerable from the Sentiments of his Heart, which every where appear in it. In the Year 1676, there appeared in the Journal of *France* three Problems proposed by Monsieur *de Comieres*, Provost of the Collegiate Church of *Ternant*. The following Year they fell into the Hands of *Monf. Viviani*.

16 *The Life of Monsieur VIVIANI.*

The two first related to the *Trisection* of the *Angle*, a Problem famous among the Ancients, and which gave them a great deal of trouble ; Monsieur *Viviani*, who had found out some new Methods for this *Trisection*, was tempted to Publish them, and give a Solution of the Problems of Monsieur *de Comieres*. Another Inducement to which was a Debt of Friendship and Gratitude, which he had a mind to discharge to the famous Monsieur *Chapelain*, who had laid great Obligations upon him, and to whom he had formerly promised to Dedicate some of his Works ; so that altho' *Monf. Chapelain* was since dead, he did not think himself free from his Promise. He therefore dedicated to the Memory of his Friend his *Enodatio Problematum universis Geometris propositorum a Cl. Claudio Comieres*, 1677. He says in his Epistle Dedicatory, that he chuses rather to run the Risque of a Matter new, and odd in appearance, than to be wanting to his Friendship and Promise ; and that instead of burying Gifts and Offerings with *Monf. Chapelain* in his Tomb, he would rather disperse them thro' the World, in which his Fame has so much resounded. He resolves the Three Problems of *Monf. Comieres* several ways, raising them always to a greater Universality, and throughout the whole Book shews the Riches and Plenty of Geometry. By the Concern with which he speaks in his Preface of those Problems thus proposed to the Geometricians, it is easie to observe that they had turned him out of the way of more important Affairs.

He names several Illustrious Mathematicians that have shewn their Dislike to these Enigma's.
Galileo

Galileo himself had advised him never to torment himself with such things. This is certain, that without making use of Mr. *Hudde's* Reasons, who says that Geometry, whether Daughter or Mother of Truth, was Free and not a Slave, one may say with less Wit, and perhaps more Truth, that such as propose these Questions have at least the advantage of having turned all their Thoughts that way, and oftentimes the happiness of expounding the Riddle by chance. But it is likewise true, that this reason can't be extended to excuse those that will not apply themselves to these Problems, or at most those that cannot resolve them; but that does not lessen the Glory of those that shall do it.

After the three Problems of Monsieur *de Comieres*, Monsieur *Viviani* resolved one more, which was then proposed by an unknown Person: But he only did it to fill up the Measure, and that he might be in a Condition to declare with greater honour, that he renounced this Trade for ever.

In 1692, he proposed in the *Acts of Leipsick*, a Problem which consisted in *finding out the way of making four Windows in a Hemispherical Vault, in such manner, that the Remainder of the Vault should be absolutely squareable.* The Problem was said to come *A. D. Pio Lisci pusillo Geometrâ*, which was the Anagram of *Postremo Galilei Discipulo*, and he signified that the Solution thereof was expected from *the secret Science of the Illustrious Analysis of the Age.* What he meant by this secret Science, was without doubt the Geometry of the *Infinitely Littles, or Differential Calculation*, which was hardly known at that time in Italy even by hear-say.

18 *The Life of Monsieur Viviani.*

The Problem of Monsieur *Viviani* was in effect soon dispatched by this Method. Monsieur *Leibnitz* resolved it the same Day he saw it, and Published it in the *Acts* of *Leipsick* after an infinite Number of ways, as did likewise Monsieur *Bernoulli* of *Basil*. The Name of the Marquis de *L'Hopital* did not then appear in those *Acts*, the War hindering him from receiving the Journal; but the Envoy of *Florence* at *Paris* having proposed the Problem to him, he presently gave three Solutions of it, and had given many more if he had not found it so very easie. This shews that the Ancient Geometricians, as Learned as they were in that Science, were not destined to give much trouble to the Moderns by their Questions about the *Differential Calculation*.

This Problem of the *Squareable Vault* was part of a Work that Monsieur *Viviani* published the same Year, 1692, under the Title of *La Struttura & Quadratura esatta dell' intero, & delle parte d'un nuovo Cielo ammirabile, ed uno degli antichi, delle Volse regolare degli Architetti*; in which he treats both as a Geometrician and an Architect of the ancient Vaults of the *Romans*, and of a New one that he himself had invented, and given it the Name of the *Florentine*. He often reduced Geometry to the use of the Arts, and always preferr'd the Usefulness of that Science to the excessive Sublimity of it.

He consider'd every thing as an importunate Distraction, that took him off from his *Aristeus*, which he had devoted to the King, from whom he had received a great many Graces.

In the Year 1699, he receiv'd one, which work'd up his Gratitude to the highest Pitch. The King chose him one of the eight Foreign *Associates* of the *Academy*, according to the Regulation that he had lately made. He was very sensible, both by the Dignity and by the small Number of his Collegues, how honourable this Office was to him; wherefore, as he himself declares, he resumed with greater Zeal his *Conjectures upon Aristeus*. In short, he published Three Books thereof in the Year 1701. and Dedicated it to the King, by an Inscription in a *Lapidary* or *Monumental* Stile, in which the *French* have the Pleasure of seeing a Stranger speak like themselves. This Work is full of the greatest Enquiries about the *Conics*; and I don't doubt that it would have been as much to his Honour, if *Aristeus* had been rais'd again by the Discovery of his Works, as it was when those of *Apollonius* were found out.

Monsieur *Viviani* could not perswade himself that he had discharged the Obligation he lay under to the King, by having Dedicated this Treatise to him; Out of the Pension which his Majesty allowed him, he built a House at *Florence*, upon a very agreeable Plan, and as Magnificent as was fit for a Private Person. This House he called *Aedes Adeodata*, and put that Title upon the Frontispiece, it being a happy Allusion to the first Name that was given to the King, as well as to the manner by which he had purchased the House. An Ingenious Gratitude, and which could not easily satisfy itself, could have invented nothing more New or more Noble than such a Monument. Monsieur *Viviani*, so worthy by his Learning, and by his

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Talents,

Talents, to receive his Majesty's Favours, became yet more worthy of them, by the Use he made after he had received them.

Galileo was not forgot in the Plan of his House: He placed his Buste, or Upper Part of his Body, upon the Gate, and his Elogium, or rather the whole History of his Life, in other Places contrived on purpose; and to the End that he might make known to the World a Monument, which of it self was durable enough, he caused a Draught of it to be engraven, and put it at the End of his Conjectures upon *Aristeus*.

The Preface of this Book abounds with his grateful Acknowledgments to several Persons, and with the Justice which he renders to all the great Geometricians of the Age, and which he pays them, as I may say, from the bottom of his Heart. He speaks with great Respect and Praise of the Abbots *Gradi* and *de Angelis*, of *Monf. Sluse*, *Huygens*, *Wallis*, *David Gregory*, and above all of *Monsieur Leibnitz*, whom he calls the Phenix of the Learned Men; and to say all in a word, the second *Galileo*; informing us, that his almost Divine Discoveries have been of great Use to the Illustrious *Marquis de L'Hopital* his Friend, to *Monsieur Bernoulli*, and several other Great Men. It is easie to judge, that under such Dispositions, tho' he had been brought up in the Ancient Geometry, and lived in a Countty abounding in Wit, he would have received without any Repugnance (if he had lived a little longer) the new Geometry of the North; and it is to be lamented, that these Lights, so worthy of his Genius, did not reach so far as him.

The Life of Monsieur VIVIANI. 21

His *Divination, or Conjectures upon Aristeus*, was the last of his Works. He died the 22^d of Septemb. 1703. at the Age of 81 Years, with all the Sentiments of a sincere Piety.

He had that Innocence and Simplicity of Manners, which are usually found in those that converse less with Men than Books; but he had none of that Roughness and kind of Savage Temper, which commonly results from our Conversation with Books only. He was Courteous, Modest, a hearty and faithful Friend, and that which includes many Virtues in one, Grateful in the highest Degree. It is true, that the general Character of his Nation may rob him of a little of this Glory; for the *Italians* commonly preserve the Remembrance of good Turns, and to speak plain, of bad ones too, more strongly than other People who are only susceptible of light Impressions; but the Gratitude which Monsieur *Viviani* has shown upon all Occasions to his Benefactors has been look'd upon as extraordinary, and attracted the Admiration even of the *Italians*.

The Place of *Foreign Associate*, vacant by his Death, has been fill'd, according to the ordinary Forms, by Monsieur *Martino Poli*, a *Roman*.



The Life of the Marquis de L'HOPITAL.



William Francis de L'Hopital, Chevalier, Marquis de *St. Mesme*, was born in 1661, of *Anne de L'Hopital*, Lieutenant-General of the King's Armies, Master of the Horse to his late Royal Highness *Gaston Duke of Orleans*, and of *Elizabeth Gobelin*, Daughter of *Claude Gobelin*, Intendant of the King's Armies, and Counsellor of State in Ordinary.

The House of *L'Hopital* consisted of two Branches; the Eldest, from which proceeded the Marquis, has join'd to the Name of *L'Hopital* that of *St. Mesme*; and the Youngest, which is now extinct, has produc'd two Marshals of *France*, and the Dukes of *Vitry*, both of 'em came from the common Stock of *Adrian de L'Hopital*, Lord-Chamberlain to King *Charles the VIIIth*, Captain of the Hundred *Swisses*, and Lieutenant-General in *Britany*; he commanded the Van-Guard of that Prince's Army, at the Battel of *St. Aubin*, in 1488.

When our Marquis was but a Child he was under the Care of a Preceptor, who at idle Hours apply'd himself to the Study of the Mathematicks. The young Scholar, who had very little Disposition, as it appear'd, for learning *Latin*, had scarce seen some of the Figures of Circles and Triangles in the Elements of Geometry, but the natural Inclination, which is always the Index of great Talents,

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Talents, presently declar'd it self: He set himself to Study with Passion, that which at the first sight would have frighten'd any Body but him. He had afterwards another Preceptor, who was forc'd by his Example to apply himself to Geometry; but tho' he was a Man of Sense and Application, his young Pupil always left him at a great Distance behind: What we attain by Labour only, does not come near to the voluntary Favours of Nature.

One Day, the Marquis *de L'Hopital*, when he was but fifteen Years old, happen'd to be at the House of the Duke of *Roannez*, where some able Geometricians, and among the rest Monsieur *Arnaud* was speaking of a Problem of Monsieur *Paschal* upon the *Cycloid*, which seem'd to be very difficult; the young Mathematician said, he did not despair of resolving it. They could hardly forgive such Presumption and Forwardness even in one of his Age; however, a few Days after he sent him the Solution of the Problem.

He enter'd into the Army, but without renouncing his dearest Passion, for he could not forbear studying Geometry even in his Tent; and he did not only retire to Study, but likewise to conceal his Application to it. For it must be confess'd, that the *French* Nation, tho' as polite as any whatever, still labours under that Kind of Barbarity, as to doubt whether Learning carry'd to a certain Degree, does not derogate from a Man's Gentility, and whether it becomes a Man of Quality to know any thing of Letters. He was so great a Master of the Art of hiding his Knowledge, and of seeming ignorant for Fashion-sake,
that

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that as long as he was in the Trade of War, those that look most narrowly into their Neighbours Faults, never so much as suspected him of being a great Geometrician; and I my self have seen some of those that were in the Service at the same Time, very much surpriz'd to hear, that a Man who had liv'd among them, and like them, was found to be one of the greatest Mathematicians of *Europe*.

He was Captain of Horse in the Regiment call'd the Colonel-General's; but the Weakness of his Sight, which was so short, that he could not see ten Steps before him, occasioning in the Service perpetual Inconveniencies, which he had long, but in vain endeavour'd to surmount, he was at last oblig'd to yield, and to abandon a Possession in which he might have equall'd any of his Ancestors.

As soon as the War had no longer any Share in him, the Mathematicks engross'd him wholly. He judg'd by the Book of *The Search after Truth*, that it's Author ought to be an excellent Guide in the Sciences; he therefore consulted him, and made a good Use of his Advice, and contracted a Friendship with him, that lasted 'till Death. His Knowledge soon arriv'd to such a Point, as that he could no longer conceal it: He was but 32 Years old, when Problems drawn from the most sublime Geometry, affectedly chosen for their Difficulty, and proposed to all the Geometricians in the Transactions of *Leipsick*, ravish'd his Secret from him, and forc'd him to confess to the Publick that he was capable of solving them.

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The first of these Problems was the following, proposed in 1693, by Monsieur *Bernoulli*, Professor of Mathematicks at *Groninguen*; To find a Curve, such as all its Tangents terminated at the Axis, may always bear a Proportion with the Parts of the said Axis, intercepted between the Curve and these Tangents. It was solv'd by none but Mr. *Leibnitz* in Germany, Mr. *Bernoulli* in *Switzerland*, Brother to him that proposed it; Mons. *Huygens* in *Holland*, and the Marquis de L' *Hopital* in *France*. Monsieur *Huygens* confesses in the *Transactions*, that the Difficulty of the Problem made him resolve at first not to trouble his Head about it, but that so new a Question had broke his Rest in Spite of him, had persecuted him without Intermiſſion, and that finally he was not able to resist it.

One may easily judge of what a Nature, in the Matter of Geometry, was a Question that appear'd so difficult to Mons. *Huygens*.

All that know the News of Learning, have heard speak of the famous Problem of the *Swiftest Descent*. Mr. *Bernoulli* of *Groninguen*, upon that Occasion, proposed the following Problem in the *Transactions* of *Leipsick*: Suppose a heavy Body falling obliquely to the Horizon, what sort of a Curve Line must it describe to fall as quick as possible? For, as it has been already related in the History of the Academy of Sciences for the Year 1699, this surprizing Paradox was demonstrated, viz. That a Streight Line, tho' the shortest of all Lines, that can be drawn between two Points given, was not, however, the Way that such a Body

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Body would take to descend in the smallest Space of Time. It was besides certain, that the Curve in Question was not a Circle, as *Galileo* believ'd it, and the Mistake of so great a Man may serve to make one sensible of the Difficulty of the Question. Monsieur *Bernoulli* proposed this Problem in the Month of *June*, 1696, and allow'd all the Mathematicians of *Europe* all the remaining part of the Year to think of it. He found that those six Months were not sufficient, and therefore he granted them the four first of the following Year; in those ten Months there appear'd but four Solutions of it, *viz.* From Mr. *Newton*, Mr. *Leibnitz*, Mr. *Bernoulli* of *Basil*, and the Marquis *de L'Hopital*, so that *England*, *Germany*, *Switzerland*, and *France*, did each of them furnish one Geometrician for the aforesaid Problem.

The same Names may be met with again at the Head of some like Solutions in the Acts of *Leipsick*, and those Gentlemen seem to be in Possession of the most uncommon and sublime Knowledges.

In the History of the Academy for the Year 1700, there is an Account of another Problem proposed, as almost all the rest were, by Mons. *Bernoulli* of *Groninguen*, but resolv'd only by the Marquis *de L'Hopital*. The Question was, *To find in a Vertical Plain, a Curve, such as the Body that describ'd it, descending freely, and by its own Weight, should always press in each of its Points, with a Force equal to its absolute Weight?* The several Difficulties, that is to say, the Beauties of this Problem, are there represented:

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The Modern Geometricians are not easy to be satisfy'd; and that which made *Archimedes* run out of the Bath along the Streets of *Syracusa*, crying, *I have found it*, would not be esteem'd by them such a glorious Discovery.

The History of the Academy for the Year 1699, makes mention of another Solution, to which few besides the Marquis de L'Hopital could attain. Mr. Newton, in his excellent Book of the *Mathematical Principles of Natural Philosophy*, has given the *Figure of a solid Body which might cleave the Water, or any other Liquid, with the least Difficulty that was possible*. But he has not shewn us by what Art or Method he arriv'd to the Determination of that Figure. His Secret seem'd to him worthy to be conceal'd from the Publick. Monf. Fatio, a famous Geometrician, undertook to discover it, and sent the Analysis of it printed to the Marquis de L'Hopital; it contain'd five large Pages in Quarto, almost wholly taken up in the Calculation. The Marquis frighten'd with the Tedioufness of it, was of Opinion, that he could as soon find out the Solution as read it; and he did effectually find one in two Days time, which was very simple and natural, and this was one of his chiefest Talents, for he did not only overtake Truth, tho' never so mysterious, but he always came at it by the shortest Way. It is a Kind of Fatality, that in all Arts the Methods, or the most natural Idea's, are not those that offer themselves the most naturally: One does almost always put one's self to too great Expence for the Discovery of those Things which one has undertaken, and there are few

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few of those happily frugal Genius's that don't spend more than 'is absolutely necessary thereto. It is true, Riches and Plenty are necessary to furnish our useless Expences ; but he that avoids them is more Wise, and more truly Rich also.

It would be too long to account here for all the Master-pieces in Geometry, with which the Marquis *de L'Hopital* and the small Number of his Equals have adorn'd the Journals of *Germany* and *France*. One would suspect, without doubt, that to enter into those Questions which were reserv'd for them, they ought to have, besides their natural Genius, some special Key, which was in no other Hands besides. They had one indeed, and that was the Geometry of *Infinitely Littles*, or *Differential Calculation*, found out at the same Time by Messieurs *Leibnitz* and *Newton*, and afterwards brought to Perfection by themselves, and the Messieurs *Bernoulli* and *de L' Hopital*.

The Illustrious Mons. *Huygens*, who was not the Inventer of the *Differential Calculation*, as Messieurs *Newton* and *Leibnitz*, nor had made use of it in all his Geometrical Studies, as Messieurs *de L'Hopital* and *Bernoulli* ; and yet who, without the Assistance of it, had attain'd to the most exalted Theories, and had rais'd himself one of the highest Reputations ; and so, like other Men, and perhaps with much more Reason, might have despised what he had not known, and treated as unprofitable that which had not been necessary to him in his great Works, was nevertheless of Opinion, both from the Merit of those who made use of this Method, and from the

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the Miracles he saw produced by it; that it was worthy of his Application : He had been so great a Man as to acknowledge that he could still learn something in Geometry, and without scruple condescended to address himself to the Marquis *de L'Hopital*, who was but little above half his Age, to be informed of the *Differential Calculation*; and doubtless this Circumstance of the Marquis's Life is much more *Glorious* to Mr. *Huygens* than to him.

Not but Mr. *Huygens* did know already by his own Experience something of the Doctrine of the *Infinite*, to which one is guided every Moment by the *Differential Calculation*; for he had been obliged to penetrate even so far in some of his nicest Enquiries, especially in that which he made for the Immortal Invention of the *Pendulum*: For the most Subtil Geometry cannot go far without entring into the *Infinite*: But there is a vast Difference between a General Knowledge of the Map of any Country, and the being able to find out all the Ways of it, and even those little Paths, which often save so much Pains to Travellers.

Monf. *Huygens* was then in *Holland*, whither he retired after he had left *Paris*, and the Academy of Sciences, of which he was one of the chiefest Ornaments. It appears by a great many of his Letters, found among the Papers of the Marquis *de L'Hopital*, and especially by those of the Years 1692, and 1693. that he communicated to Monf. *L'Hopital* his Difficulties upon the *Differential Calculation*, and that when any thing stop'd him, he did not impute it to the Method, but to
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his not being sufficiently Master of it, and said, that *he saw with Surprise and Admiration the Extent and Fertility of this Art, that on which side soever he turned himself, he discovered new Uses of it; and finally, (these are his own words) he conceived in it a Progress, and an Infinite Speculation.* He did even publicly declare in the Acts of *Leipsick*, that without a *Differential Equation* he could never have arrived at the Discovery of a Curve, of which the Tangents and the Parts of the Axis always bear a Proportion to each other: And he adds in the same Acts, *That we must observe in this Problem, a new and singular Analysis, opening the way to a great many things upon the Theory of the Tangents, as has been extremely well observed by the illustrious Inventor of a Calculation, without which we should have found it very difficult to have penetrated so deeply into Geometry.* He writ at the same time to the Marquis de *L'Hopital*, that he was beholden to his Instructions for this *Differential Equation*, by the help of which he had attained to the Solution of the Problem.

'Till this time the Geometry of the *Infinitely Littles* was only a kind of Mystery, and as one may say, a Cabalistical Science, monopolized by five or six Persons. Oftentimes the Solutions were published in the Journals, without mentioning the Method of coming at them, and even when that was discover'd, it was no more than some Rays of the Science that broke out, but were quickly overcast. Again, the Publick, or to speak more properly, the small Number of those who aspired to the Sublime Geometry, were struck with an unprofitable

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table Admiration, but not enlighten'd by it, and our Artists found the Means of attracting their Applauses, and at the same time of with-holding the Instruction wherewith they ought to have paid them.

Monfieur *de L'Hopital* was resolved to difclose, without Referve, these hidden Treasures of the New Geometry, which he did in his famous Book *of the Analysis of the Infinitely Littles*, published in 1696. there were laid open all the Secrets of the Geometrical Infinite, and of the Infinite of Infinites; in a word, of all those different Orders of Infinites, which raise themselves one above the other, and form an Edifice the most amazing and the boldest that Human Mind durst ever have projected.

As there are Determinate Relations between the Finite Greatnesses, which are the sole Object of Mathematical Enquiries, and the Greatnesses of these different Orders of Infinites; we come by the way of the Infinite to the Knowledge of the Finite, to which no other Method could ever attain that had not the Boldness and the Art at the same time of handling the Infinite. The Book of the Infinite Littles was therefore all over shining with the unknown Truths of the Ancient Geometry, and Truths that were not only unknown, but also unaccessible to that kind of Geometry. The ancient Truths were as it were lost there in the Crowd of the new ones, and the Facility with which they were discover'd made Men regret the Pains they had formerly cost the first Inventers; Demonstrations, which by other Methods would have required a vast Compass, supposing that it

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had been possible to attain to them, or which even in the hands of another Geometrician instructed in the same Method would have still been tedious and embarrassing, were of such a plainness and shortness, as render'd them almost suspected.

Such is the Effect of General Methods when one has been able to find them out once. One is at the Fountain-head, and one has nothing more to do, but to let one self be carried down the gentle Stream of the Consequences. One single Rule of Monsieur *de L'Hopital's* Book gives the *Tangents* of all the *Curves* imaginable; another, the Application of all the Greatest or Smallest, or all the Points of *Inflexion* and of *Return*, or of all the *Evolutes*, or of all the *Catoptrick* or all the *Dioptrick Curves*. Entire Treatises made by great Authors are reduced sometimes to some Corollaries, which one meets in the way, and which one hardly distinguishes in the Crowd; the whole relates to kinds of Systems which *Monf. de L'Hopital* has begun to bring into Geometry, and which will place that Science in a new Light.

There are, especially upon the Mathematicks, more good Books, than Books well writ; that is to say, there are enough that may Instruct, but few that do it with a certain Method, and as one may say, with a certain Agreeableness; 'tis well enough if we have a good Matter in our hands, the Form is too much neglected: But Monsieur *L'Hopital's* Book was as well composed as good in it self, having found out the Art of Reducing an infinite Number of things into a small Space, and with that Brevity and Exactness, that are so delicious to the Mind; the Order and Regularity
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of his Idea's have almost render'd the use of Words unnecessary; His design is only to make you think, being more careful to excite the Enquiries of other People, than ambitious of displaying his own Discoveries.

Accordingly that Work has been received with an universal Applause; for one may justly call it universal, when one can so easily reckon up throughout all *Europe* the Votes of those that have given a Negative to it, and there will always be some Negatives put upon New and Original things, especially when they are required to be well understood. Those who observe the Events of the History of Sciences know with what Greediness the *Analysis of the Infinitely Littles* has been laid hold on by all the Geometricians of this present Age, to whom the old and the new Methods are both indifferent, and who have no other Interest than that of chusing the best Path. As the Design of the Author was principally to raise Mathematicians, and to sow the Seeds of the High Geometry in the Minds of Men, he has had the Pleasure of seeing the daily Fruits thereof, and of observing that Problems, the Solution of which were formerly reserved only for such as were grown old among the Thorns of the Mathematics, were now become the first Essays of Young People. This Revolution will probably grow greater and greater, and he in time would have had as many Disciples as there were Mathematicians in the World.

After having seen the Usefulness of his Book about the *Infinitely Littles*, he engaged in another Labour, no less proper to make Geometricians,

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This Design of his compriz'd the *Conick Sections*, the *Geometrical Places*, the *Construction of the Equations*, and a *Theory of the Mechanick Curves*. This was properly the Plan of Monsieur *Descartes's* Geometry, but more dilated, and more complete. He did not pretend that this Work was to be as New or as Sublime as the first; He might have turned his Enquiries towards the *Integral Calculation* which follows, and supposes the *Differential*, but is attended with much greater, and as yet unfurmountable Difficulties, and thereby at present employs the most Learned Geometricians, and is become the Object of their Ambition; but he prefer'd a Business that was to be more beneficial and necessary to the Publick, and his Zeal for Geometry got the better of the Concern for his own Glory. However I am a Witness, that he could not forbear regretting the *Integral Calculation*.

This Work was almost finished when he was seized in the beginning of the Year 1704. with a Fever, that at first appeared by no means dangerous; but when it was found to resist all the different Remedies made use of by the Physicians, his Friends began to fear for him, nor did the Patient stay for any greater Danger to put him in Mind of his Death, but prepared himself for it in a most edifying manner; soon after which he fell into an Apoplexy that put an end to his Life the Day after it took him, being the 2^d of February, and the 43^d Year of his Life.

Some have attributed his Death to his excessive Labours in the Mathematicks, and that which may confirm it is a Circumstance I have learnt from

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from himself, viz. That many Mornings which he had devoted to that Study, often became whole Days before he was aware of it.

He had a mind to have quitted it, out of care for his Health, but he never could abstain for above four Days at a time; besides one may easily believe that he must have made vast Efforts of Mind, when one considers how far he was come at the Age of 43 Years, and how much time in so short a Life he had squander'd away out of Love to the Mathematicks. He had been in the Service; he was of that Quality which engaged him to a great Number of Devoirs; he had a Family and the Consequence of it, Domestick Cares, a good Estate of his own to manage, which always brings Business with it; besides which, he lived in the World, and with it, in a manner like those whose idle Employments are their sole Business; nor was he an Enemy to Pleasures; these were Avocations enough in Conscience; and let his Talents have been never so proper for the Mathematicks, it was impossible but that his want of Time must be supplied with a prodigious Application; however it did not appear that his Studies affected his Health, he had the Appearances of the best and strongest Constitution as could be desired. He was by no means Melancholly or Pensive, on the contrary rather inclinable to Mirth; so that his great Mathematical Genius did not seem to have cost him any thing.

In his most ordinary Discourses one perceived the Justness, Solidity, and in a word, the Geometry of his Soul; he was of an easie Conversation, and of a perfect Honesty, open and sincere,

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cere, consenting to what he was, because he was so, but making no Advantage of it, the true Modesty of a great Man, ready to own his Ignorance, and to receive Instructions even in matters of Geometry, if it were possible to be instructed therein; by no means Jealous, not for want of knowing his own Superiority, but out of a natural Equity; for without that, those that believe themselves, and even those that are Superiour to others, are notwithstanding jealous of others.

He married *Marie Charlotte de Romilley de la Chesnelaye*, a Lady of an Ancient and Noble Family in *Britany*, and who brought him a great Estate. There was such a Harmony and Union between them, that he inspired her with his Genius for the Mathematicks. He left by her one Son and three Daughters.

His Place of *Honorary Academist* was filled by the Marquis of *Daugeau*, Governour of *Touraine*, Counsellor of State in Ordinary, and Grand Master of the Royal and Military Orders *de Nôtre-Dame du Mont Carmel*, and of *St. Lazare de Jerusalem*, &c. and one of the Forty Members of the *French Academy*.



The LIFE of Monsieur BERNOLLI.

Ames Bernoulli was Born at Basil the 27. December, 1654. He was Son of Nicholas Bernoulli, who is yet living, and has considerable Employments in that Canton. One of the Brothers of the Gentleman whose Life we are writing is in a yet higher Station than his Father.

Monsieur Bernoulli was Educated after the usual manner of his Time; He was designed for a Minister, and accordingly instructed in *Latin, Greek,* and the Philosophy of the Schools, but nothing of Geometry; however, having seen by chance some Geometrical Figures, he was struck with those Charms of which few Men in the World are sensible. He had hardly any one Book of the Mathematicks, nor durst he make use of those he had but by stealth, so that you may be sure he had no Master, but his Inclination joined with a great Capacity became his Preceptor. He likewise apply'd himself even to Astronomy; and as his Father, who had other Views for him, always opposed those Studies, he expressed his Circumstances by a Device representing *Phaëton*, guiding the Chariot of the Sun, with a Latin Inscription, which signified, *I am among the Stars in spite of my Father.*

He was but 18 Years old, and could hardly otherwise be counted a Mathematician than by his violent Propensity for the Mathematicks, when he gave

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gave the Resolution of that Chronological Problem, difficult enough to one of his Age, by which the Years of the Solar Cycle, of the Golden Number, and of the Indiction being given, the Year of the *Julian* Period was to be found.

At the Age of 22 Years he went to Travel; being at *Geneva*, he taught a young Woman to Write who had lost her Eyes within two Months after she was Born, and invented a new Method for that purpose, having discovered both by Reason and Experience the Inefficacy of that which *Cardan* proposes. At *Bourdeaux* he composed universal *Gnomonick*-Tables, which are now ready for the Press. After having seen *France*, he returned to his own Country in the Year 1680. there he began to Study the Philosophy of *Descartes*. That Excellent Book did more enlighten than convince him, and he drew from that great Author strength enough to engage even with him afterwards.

At the end of the Year 1680, there luckily appeared a Phenomenon fit to exercise a young Philosopher; it was a Comet which has occasion'd several famous Works, and among the rest the First that Mr. *Bernoulli* ever published, and which he called *Conamen Novi Systematis Comentarum, pro motu eorum sub calculum revocando, & apparitionibus predicendis*. He supposes that the Comets are Satellites, or Moons, of the same Planet, raised so high above *Saturn*, tho' placed in the Vortex of the Sun, that it is always invisible to our Eyes; and that those Moons are not visible neither, but when they are in the lowest Part of their Circle, and in the nearest Position to us. From thence he concludes that
Comets

The Life of Monsieur BERNOLLI. 40

Comets are everlasting Bodies, and that their Return may be foretold, which is also the Opinion of Monsieur *Cassini*. According to the System and Calculations of Monsieur *Bernoulli*, the Comet of 1680, will appear again upon the 17th of May 1749, in 1 Degr. 12 Min. of *Libra*. This is a Prediction bold enough, considering the Exactness of the Circumstances.

Here I cannot forbear relating an Objection which was proposed to him very seriously, and which he condescended to answer in as grave a manner: It was, that if Comets are regular and ordinary Stars, they can no longer be esteem'd extraordinary Tokens of the Wrath of Heaven. He attempts several Ways of solving it, and at last comes off in this manner: He asserts, That the Head of the Comet being eternal, cannot be assign'd, but the Tail may, because according to him, this last is only accidental. Such Measures were the learned Men about 25 Years ago oblig'd to keep with popular Opinions. At present we have got over it; that is to say, the greatest Part of the World are cured of their Whims about Comets, and the Fruits of sound Philosophy spread themselves farther and farther: It would be a good thing, if it were practicable, to note the Epoca of the End of those Errors which she has destroy'd.

In the Year 1682, Monsieur *Bernoulli* published his Dissertation *De gravitate Aetheris*; he does not only treat therein of the Weight of the Air, so incontestable and so sensible by the means of the Barometer, but chiefly about that of the *Aether*, a Matter much more fine and subtile than

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than the Air we breath. It is to the Weight and Pressure of that Matter that he refers the Hardness of Bodies. In his Preface he protests, that when he had form'd this System, he did not remember that he had ever met with it in that famous Book, call'd *The Search after Truth*, and applauds himself for having fallen upon the same Opinion with Father *Malbranche*; and, what is more remarkable, that he had attain'd to it by the same Methods.

As the Alliance between Geometry and Natural Philosophy produces the chiefest Usefulness of the former, and all the Solidity of the latter, he set up Societies, and a kind of an Academy, in which he made those Experiments that were the Foundation or the Proof of the Geometrical Calculations, and he was the first Man that establish'd in the City of *Basil* this Way of Philosophising, the only reasonable one, and which nevertheless has been so long in appearing.

He had already penetrated into the most abstruse Parts of Geometry; and as he study'd it, he render'd that Science more perfect by the Discoveries he made in it; when in the Year 1684, the Face of Geometry was almost chang'd at once. The illustrious Monsieur *Leibnitz* publish'd in the Transactions of *Leipsic*, some Essays of his new Differential Calculation, or, as he styles it, *Infinite Parva*, of which he conceal'd both the Art and Method. As soon as Messieurs *Bernoulli* (for the younger Brother, a famous Geometrician, has an equal share in the Glory of it) perceiv'd by the little they could see of this Calculation, how great the Extent and Glory of it would

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would be, they obstinately set themselves to discover the Secret, and to carry it away from him that had invented it; in which they succeeded and perfected the Method to such a Degree, that Monsieur *Leibnitz*, out of a Sincerity worthy of a Great Man, declar'd, That it belong'd to them as much as to him. Thus it is, that the least Ray of Truth breaking thro' a Cloud sufficiently enlightens Great Minds, whilst the naked Truth can hardly make any Impression upon others.

Monsieur *Bernoulli's* Country did Justice to a Citizen who had been so great an Honour to it, for in the Year 1687, he was chosen, by a unanimous Consent, Professor of Mathematicks in the University of *Basil*: It was then he had an Opportunity to exert a new Talent, which was that of Teaching; for a Man has been capable of attaining to the highest Pitch of Learning, and yet unable to lead others up to it, and sometimes it costs the Mind more Pains to descend again, than to continue soaring. Monsieur *Bernoulli*, by the great Easiness and Nicety of his Lessons, and by the great Progress his Pupils made in a very small time, attracted a Number of Strangers to *Basil* to hear his Lectures. The Exercises which his Office of Professor requir'd of him, produc'd, among other Fruits, all that he has publish'd upon the Infinite Series or Ranks of Numbers. The Question is, To find the Amount of a Sum of an Infinity of Numbers, regulated according to some Order or Law? and without doubt, Geometry would never shew greater Boldness than when she pretends to make her self Mistress of Infinity it self, and to treat
it

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it as something Finite; thereby we discover the Rectifications or Quadratures of Curves; for all Curves may pass for Infinite Continuations of Right Lines Infinitely little, and the Spaces which they comprise, for an Infinity of Spaces infinitely little, all terminated by Right Lines. One while we find that these Sequels or Continuations which comprehend an Infinity of Terms, are nevertheless but equal to a certain Finite Term, and then the Curves which they represent are either Rectifiable or Squarable; sometimes we find that these Sequels are lost in their Infinity, and are absolutely out of the Reach of any Calculation; in which Case the Length of the Curves, or their Spaces, do likewise escape our Enquiries. *Archimedes* seems to have been the first that found the Sum of a Geometrical Progression infinitely decreasing, and thereby most ingeniously discover'd the squaring of the Parabola. *Dr. Wallis*, the famous *English* Mathematician, upon these Sequels compos'd his *Aritbmetick of Infinites*, and *Messieurs Leibnitz*, and *Bernoulli* have carry'd this Theory much farther since his Time.

But the Object of *Monsieur Bernoulli's* most constant Pains was the Calculation of the Infinitely Littles, and the Enquiries where it was necessary. He, and the small Number of his Equals, had found out, as it were, a New World, unknown 'till then; and of a difficult and even dangerous Access, but which recompenc'd their Labour with immense Riches, and which were not to be met with in the Old World.

Having

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Having already given an Account of the late Marquis *de L'Hopital*, I have in some manner describ'd Monsieur *Bernoulli*, because they have often given by that Method, which was common to them both, a Solution of the same Problems, which they could have laid hold on no other Way. We will not therefore repeat what has been there said, but only add some of Monsieur *Bernoulli's* particular Discoveries.

The Differential Calculation being laid down, every one knows how necessary the Integral Calculation is; this being, as one may call it, the Reverse of the other; for as the Differential Calculation descends from Finite Greatness to their Infinitely Littles, so the Integral Calculation does ascend from Infinitely Littles to Finite Greatness; but the Ascent is painful, and in some Cases as yet impossible.

In the Year 1691, Monsieur *Bernoulli* publish'd two Essays upon the Integral Calculation, and they were the first that have hitherto appear'd, by which he open'd a new Way to the Geometricians. These two Essays related to the Rectification and Quadrature of the two different kinds of Spirals; one is form'd by the Extremities of the Ordinates of an ordinary Parabola, of which the Axis is rolled up in a Circle; the other is the Logarithmical Spiral, which always makes the same Angle with its Ordinates, concurring in its Center. And as the Curve, which is call'd *Loxodromical*, describ'd by a Vessel which always follows the same *Rhomb* of the Wind, does likewise always make the same Angle with all the *Meridians*, it follows, that if the Meridians were
Right

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Right Lines, concurring to the Pole, the Loxodromical would become the Logarithmical Spiral; from whence Monsieur *Bernoulli* took Occasion to pass from the Logarithmical to the Loxodromical Spiral, and discover'd a great many new things, and very curious with respect to the Longitudes and Navigation.

About this Time the Problem of the *Linea Catenaria*, propos'd by him, made a great Noise among the chiefeft Geometricians. It is the Curvity made by a Chain fasten'd at each End, equally heavy in all its Parts, each of which Part is drawn down by its own Weight, and at the same Time stopp'd by the Points. After that Messieurs *Leibnitz*, *Huygens* and *Bernoulli* his Brother had resolv'd the Problem, and determin'd this Curvity, he prov'd in the Year 1692, that it was the same with a Sail swell'd by the Wind: And as he then began his Enquiries and Discoveries upon the Curvity, which a Spring would make upon one of its Extremities fasten'd upon a Plain, and the other carry a Weight, he shew'd, that the same Sail, which being swell'd with a Horizontal Wind, would be bent into the *Catenaria*, were swell'd with a liquid Matter that should gravitate upon it Vertically, it would be bent like a Spring, or *Elastically*, for that's the Name he gives to this sort of Curve. These Determinations are not the simple Sports of Geometry, and only to be esteem'd for the Difficulty of their Solution, but they likewise occur in the nicest Disputes of Physicks or Mechanicks, when the Question is to discover with great Exactness the Action of *Liquids* or of *Weights* &c.

To

To forbear entering into a longer detail of *Monf. Bernoulli's* Geometrical Enquiries, it shall suffice to give you here a Sketch of his Theory of the Curves that slip or move upon themselves. Whatever Curve is proposed, he considers it as immoveable, and at the same time he supposes that another Curve equal and like, that is to say of the same Kind, slips upon it and applies all its Points to the Curve that is under it, one after the other : Joyning to this Consideration that of the Evolute, which would have produced the proposed Curve, he draws from the sliding of this Curve upon it self not only a *Roulette* or *Cycloid*, described after the ordinary manner by a fixed Point of the moveable Curve, but likewise the *Caustick* by *Reflexion*, and besides two Curves, the first of which he calls the *Anti-Evolute*, and the second the *Pericaustick*; and to carry himself through this Labyrinth of different Laws, and to enable him to determine the Nature of them, it is only necessary to know the first, which is the Spring of all the rest.

By this means he attains to a wonderful Propriety of the Logarithmical Spiral, which is, that all the Curves, which either produce it, or are produced by it, after the manner we have explained them, its *Evolute*, *Caustick*, *Cycloidal Anti-Evolute* and *Pericaustick* are other Logarithmical Spirals, equal and like in all things to that from which they are generated. It is easie to judge that such like Resolutions require a great Apparatus of Geometry, and must needs be the utmost Efforts of a Mathematical Genius.

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These Rollings of the Curves guided Monf. *Bernoulli* to the Discovery of the two general Formules of the *Cauſticks* by *Reflexion* and *Refraction*, which comprise two Sections of the Marquis de *L'Hopital's* Book, or rather the whole Art of *Catoptricks* : But Monsieur *Bernoulli* ſuppreſſed the Analysis of the Formules, and Monsieur de *L'Hopital* has revealed the Myſtery thereof.

All theſe Enquiries, and a great Number of others as profound as theſe, which we muſt paſs over in Silence, have been performed by the Calculation of the Infinitely Littles; and was it poſſible to prove its Excellency better, and at the ſame time to teach the Art of handling it? And ſo likewiſe this Method is become that of all the great Geometricians without Exception; and tho' it is ſometimes a little crabbed and thorny, it is much more eaſie to learn the Practice of it, than to advance further without its help.

When the Royal Academy of Sciences had received from the King in the Year 1699. that Eſta bliſhment by which they were allowed to chuſe eight Foreign Associates, all the Votes immediately fell upon the two *Bernoulli's* in that ſmall Number. The *Elector* of *Brandenbourg* having likewiſe eſta bliſhed an Academy, at the Head of which he placed the famous Monsieur *Leibnitz*, both theſe Brothers were made Fellows of it in the Year 1701. Tho' they were abſent they have always fulfilled the Duty of Academifts by their excellent and ſingular Tracts, with which they have enriched our Hiſtory. In that of the Year 1702. we publiſhed the *Indefinite Section of the Circular Arches* of Monsieur *Bernoulli* of Baſil. In 1703,

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his *Theory of the Centre of Oscillation*; and in the present Year, we have seen his new Hypothesis of the Resistance of Solids, and the Analysis of his Elastick Curve. In the *Acts of Leipzig* he had already given some Idea, but imperfectly, of the greatest part of these Discoveries, but he did not communicate them to the Academy, 'till he had put them into such a Condition as was to his own Satisfaction.

Whilst the Professor of *Basil* raised himself so great a Name, his Brother, Professor also of Mathematicks at *Groningen*, made no less Noise; they both ran the same Course and with equal Paces. The Learned Men of the first Rank could hardly attain to that Degree, if they were not passionately affected for their particular Science, and had a taste for it superior to every thing else. A lively Emulation excited it self between the two Brothers, which was yet more fomented by their Distance, and brought them to speak to one another only in the Publick Journals, and might have served to create a Misunderstanding, if that could possibly have happen'd between two such dear Friends. At last the eldest Brother gathering his whole strength together, shot out, as I may call it, a Problem, which he directed not only to all the Geometricians, but likewise to his Brother in particular, promising him publicly a certain Sum if he could resolve it. He did it, and very quickly too, but gave the Solution without an Analysis. *Monf. Bernoulli* of *Basil*, who found this Solution to be partly different from his own, desired to see the Analysis of it, that he might discover from whence arose the Difference of the Solutions:

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But so many difficulties intervened about the Judges that were to examine this Analysis, and some other Circumstances of the Judgment, that they have not yet been determined; the Detail of it would be too long, it may therefore suffice, that the Publick be informed that this Problem related to the Figures called *Isoperimeters*. Amongst an Infinity of possible Curves, which have the same *Perimeter* or the same Length, it was necessary to find out by some General Rule, those, which under certain Conditions, included the greatest or smallest Spaces, or by revolving about their Axis, produced the greatest or the smallest Superficies, or the greatest or smallest Solids. One may guess at the Difficulty of the Problem, by the Design wherewith it was chosen.

'Twas this Mr. *Bernoulli* who had the care of the Edition of *Descartes* his Geometry, which was publish'd at *Basil*: He was so full of these Matters, that the Proofs which he had to correct, could not pass through his Hands without producing new Thoughts and Reflections; and he embellished the Works of that great Philosopher, which tho' they were done in hast, and as he calls them Tumultuary, are yet very Curious and Instructive.

His continual Labours, occasion'd by the Duties of his Place, by his Thirst after Knowledge, and the Pleasure he took in his Success, were probably the cause of the Gout, which seized upon him very early, and ended at last in a slow Fever, of which he died the 16th of *August*, 1705. Aged fifty Years and seven Months. Two or three Days before his Death, at the time of his most serious Cares, he intreated *Monf. Herman* his Countryman, particular

particular Friend, and an illustrious Geometrician, to return his Thanks to the Academy of Sciences, for the Honour of having admitted him into their Body, and according to the Example of *Archimedes*, who would adorn his Tomb with the finest Discovery he had made in Geometry, and order'd, that a Cylinder circumscribed to a Sphere should be drawn upon it; *Monf. Bernoulli* likewise order'd, that there should be put upon his, a Logarithmical Spiral with these words, *Eadem mutata resurgo*, a happy allusion to the Hope of Christians represented in some manner by the Properties of this Curve. He finished a great Work *De Arte Conjectandi*; and tho' nothing of it has yet appeared, we shall venture to give some Idea of it upon the Credit of *Monf. Herman*. The Rules of any Play being supposed, and the Players being of equal Strength, one may, in what condition soever the Game be, determine by the Advantage which one of the Gamesters has over the other, what odds are to be laid that he shall win. The Wager changes according to the different Conditions of the Parties, and when one will consider all these Changes, one finds sometimes *Series* or Sequels of regulated Numbers, and even of new and singular ones. If you suppose the Gamesters to be unequal, the Question will be, what Odds the Stronger ought to give the Weaker, or reciprocally, a certain Advantage being granted by one to another; the Question will be, how much stronger he that gives is than he that takes, and it must be observed that the Odds or the Strength are incommensurable, so that the two Gamesters can never be made entirely equal. The Ratiocinations

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which these sort of Matters require, are usually very nice and fine, and composed of a great number of Views, some of which may be lost, and consequently more subject to Error than other Mathematical Reasonings. For Example, two equal Gamesters having agreed to play four Setts each, and one has got three and the other two, the reasoning must be very nice to determine exactly that one may lay three upon his Head that has got three Games, and one upon his that has got two ; This is one of the most simple Cases, but by this you may judge of those that are infinitely more complicated : Some great Mathematicians, and chiefly Messieurs *Paschal* and *Huygens*, have already proposed or resolved some Problems upon this Subject, but they have only skim'd, as I may say, and not enter'd into the Matter ; but *Monf. Bernoulli* has taken a greater Compass, and founded it more deeply, he has even carried it to Moral and Political Things, and it is those which will be found the most new and surprising in his Work. In the mean time, if we more closely consider the Affairs of Life, upon which we are to deliberate daily, we shall find that we ought to proceed in those Deliberations as in our Wagers about Playing, that is, we should compare the number of Cases, in which a certain Event will happen, to the number of those in which it will not come to pass ; that being done, one should know exactly, and one might express by Numbers how much better Party would be that we embrace, than that which we reject. All the Difficulty is, that many Cases escape us in which the Event might equally happen, or not happen, and the
more

more there are of these unknown Cases, the more uncertain is the Knowledge which Side we ought to take. The Train of these Idea's led *Monf. Bernoulli* to this Question, Whether the Number of unknown Cases always lessening, the probability of the Side one ought to take, does necessarily increase in Proportion, so that at last, it arrives to such a degree of Certainty as one would have it? It should seem that there was no Difficulty in maintaining the affirmative of this Proposition; nevertheless *Monsieur Bernoulli*, who was fully Master of the Matter, assured us, that this Problem was much more difficult than that of *Squaring the Circle*, as it would in Comparison be much more useful; for it is not so glorious for the Spirit of Geometry to reign in Natural Philosophy, as it would be in matters of Morality, which are very complicated, casual and changeable, and the more obstinate and stubborn the Matter it has to deal with, is the greater Honour it would acquire in overcoming it.

Monf. Bernoulli was of a bilious and melancholly Temper, a Disposition which above all others produces in the Mind that Ardour and Constancy which are so necessary for great Things: It produces in a Man of Letters an assiduous and obstinate Study, and by that same Study fortifies itself more and more. In all the Enquiries and Discoveries which *Monf. Bernoulli* made, his Steps were slow, but sure; neither his Genius, nor habitual Success inspired him with Confidence: He published nothing which he did not strictly examine over and over, and he always stood in fear

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of the Opinion of that World which had shown so great a respect for his Productions.

He was married at the Age of 30 Years, and left a Son and a Daughter.

His Place of *Foreign Associate* was filled by *Monf. Bianchini*, one of the Pope's Chamberlains, and Canon of *St. Laurence* in *Damazo*.



The LIFE of Monsieur AMONTONS.



William Amontons was Born in the Year 1663. He was the Son of a Lawyer, who having left *Normandy* which was his Country, came and settled at *Paris*. Whilst he was in his Studies, he fell into a Distemper which made him so deaf, that it obliged him almost to quit all sort of Company, at least all unnecessary Company. Thus being reduced to live by himself, and having none but his own Meditations for his Companions, he began to turn his Thoughts towards the *Mechanicks*, and undertook at first the most difficult of all Machines, or rather the only impossible one, I mean that of the *Perpetual Motion*, of which he neither knew the Impossibility, nor the Difficulty. Whilst he was at work at it, he easily discover'd that there ought to be some Principles in this Matter, and that unless he knew them, he lost both his Time and Pains. He set himself then to Geometry, tho' according to the Custom of all Families, his own opposed him in it, and not without reason certainly, if

if People apply themselves to Sciences only with a design to make their Fortune.

We are assured that he would never make use of any Remedy against his Deafness; whether it was that he despaired of being cured, or that he found his account in the redoubling of his Application and Attention, which that Deafness was the occasion of; like one of the Ancients who was said to have put out one of his Eyes that he might not be diverted from his Philosophical Meditations. *Monf. Amontons* learned *Drawing, Measuring and Architecture*, and was employed in several Publick Works; but he was not long without raising himself higher, for to that mechanical Science, which produces our several Arts, and is only employed about our necessary Affairs, he joined the Knowledge of the Sublime *Mechanism* of the Universe.

The Instruments, such as Barometers, Thermometers, and Hygrometers, made use of in measuring Physical Variations, which not long since were either wholly unknown to us, or only known by the confused and uncertain relation of our Senses, are perhaps, among all the useful Inventions of Modern Philosophy, those in which the application of the Mechanicks to natural Philosophy is most nice; besides as we were contented with the first lucky Hit, or with the first Idea which these Inventions happily produced, they remained either Defective in themselves, or very little useful. *Monf. Amontons* studied them very diligently, and in the Year 1687, when he was but 24 Years old, he presented the Academy with a new *Hygrometer*, which was very much approved by them.

He

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He likewise propos'd to Monsieur *Hubin*, a famous Enameler, and a very skilful Man in these Matters, the different Idea's he had for new *Barometers* and *Thermometers*, but Monsieur *Hubin* had prevented him in some of his Projects, and did not much regard the rest, 'till he took a Journey into *England*, where the same things were propos'd to him by some of the principal Members of the *Royal Society*.

Perhaps it will not be look'd upon any otherwise than as an Amusement or Pastime of the Mind, but however a very ingenious one, that he invented a Method of communicating the Thoughts of one Person to another at a very great Distance : For Example, from *Paris* to *Rome*, in so short a Time as three or four Hours, in such a Manner, that those who liv'd between should know nothing of the Matter ; and yet this Proposition so paradoxical, and so chimerical in Appearance, was executed in a small Extent of Country, once before the Duke of *Orleans*, and at another time before the Dutchess ; for tho' Monsieur *Amontons* did not at all understand the Art of making his Court to great Men, yet his Merit had already made him known to several Great Princes.

The Secret consisted in placing People in several Posts, at certain Distances from each other, who by the Help of Telescopes, could perceive certain Signals at the Post before them, and transmit them to the next behind 'em, and so on ; these different Signals, were so many Letters of an Alphabet, of which they only had the Cypher at *Paris* and at *Rome*. The great Reach of the Tele-

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Telescopes, made the Distance of the Posts; the Number of which, was to be as few as possible; and as the second Posts transmitted the Signals to the third, as soon as ever he receiv'd them from the first, the News was carry'd from *Paris* to *Rome* in almost as short a time as was necessary to make the Signals at *Paris*.

In 1695, Monsieur *Amontons* publish'd the only Book that we have printed of his, and dedicated it to the *Academy of Sciences*, the Title of which is, *Physical Observations and Experiments upon the Construction of a new Hour-Glass, and upon Barometers, Thermometers, and Hygrometers*. Altho' the *Clepsydra's*, or Water-Hour-Glasses, so much in Use among the Ancients, have been quite laid aside by us, on Account of the Clocks with Wheels, which are much more exact and convenient, Monsieur *Amontons* did nevertheless take a great deal of Pains in forming his *Clepsydra*, hoping that it might be of Service upon the Sea; for as he had made it, the most violent Motion of a Ship, which infallibly disorders all Clocks, could not affect this Machine. One may see in his Book with how much Art that *Clepsydra* was prepar'd; nor is it likely that it interfered with many of the ancient Inventions.

He was admitted into the Academy in the Year 1699, at the time when the King gave them their new Rules. Soon after which, he produc'd, at one of the Meetings, his Theory of *Frictions*, which has given so much Light to a Matter that has hitherto been obscure, and yet of great Importance in the Mechanics. That was succeeded by his new *Thermometer*, an Invention which is
not

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not only useful in the Practice, but has also furnish'd us with new Views for Speculation. Our Histories have spoken fully of these Discoveries, and given an Account of his Rectify'd Barometer, and of his Barometer without Mercury, for the Use of the Sea, and of the new and curious Experiments he has made about the Nature of the Air.

Monsieur *Amontons* had a singular Talent for Experiments, fine and happy Notions of Things, and a great many Expedients to remove any Inconveniencies, and great Dexterity in executing his Projects, so that it seem'd as if Monsieur *Mariot*, so famous for the same Talents, had been reviv'd in him.

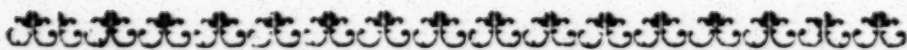
We do not therefore scruple to compare a simple *Pupil*, such as Monsieur *Amontons*, was to one of the greatest Members that ever our Academy had; nor does the Name of *Pupil* imply any Distinction of Merit among us, nor signify any thing more than a lesser Degree of Seniority, and a kind of Survivance. Monsieur *Amontons* enjoying a perfect Health, which even shew'd it self by all the External Appearances, and not being Subject to any Disease, leading, and having always led the most regular Life in the World, was all of a sudden seiz'd by an Inflammation of the Bowels, which turn'd to a Mortification in a very few Days. He died the 11th of October 1705, at the Age of 42 Years, and about two Months.

The Publick loses by his Death several useful Inventions he was about, *viz.* upon the Printing-Press, upon Ships, and upon Waggon, or Carriages. What has appear'd of his may secure us,
that

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that whatever he thought possible would certainly stand any Trial, and the Spirit of Invention naturally subtle, bold, and sometimes presumptuous, was in him accompany'd with all the Solidity, all the Modesty, and even all the Diffidence necessary to it.

The Qualities of his Heart were yet preferable to those of his Mind; there was so natural and so unaffected a Sincerity in it, that it was impossible to be deceiv'd by it; a Simplicity, Freedom, and Candour, which the small Correspondence he had with Men might preserve, but could not bestow upon him; he was intirely incapable of setting himself out otherwise than by his Works, or of making his Court otherwise than by his Merit, and, by Consequence, almost entirely incapable of raising a Fortune.



The LIFE of Monsieur DUHAMEL.

 *Obn Baptist Dubamel* was born in the Year 1624, at *Vire*, in the Lower Normandy. *Nicholas Dubamel* his Father was a Lawyer in the same Town, where, without any regard to his private Interest, his chief Care was to make up those Quarrels that were brought to him, which sometimes occasion'd others between him and the Judges of the Place.

Monsieur Dubamel, the Son, perform'd his first Studies at *Caën*, but learned Rhetorick and Philosophy at *Paris*. At the Age of 18 Years, he

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he compos'd a little Treatise, in which he explain'd, with one or two Figures, and after a very easy Manner, the three Books of *Sphericks of Theodosius* ; he added to it a very short and plain *Trigonometry*, with a Design to facilitate the Entrance into *Astronomy*. In one of his later Works, he says, That the Vanity of Youth stirr'd him up to publish the other ; but few People of the same Age are troubled with such sort of Vanity. The Inclination which carry'd him to the Sciences, must have been already very general, and very far extended, since it did not suffer him to pass by the Mathematicks, so little known, and less cultivated in those Times and Places in which he studied.

At the Age of 19 Years he was admitted into the Convent of the Fathers of the Oratory, there he remain'd ten Years, and left it for the Parsonage of *Neuilli*, upon the *Marne*. Between these two Periods he join'd to the Duties of his Functions a great Application to Reading.

Natural Philosophy was at that Time like a great Kingdom dismember'd ; the particular Provinces or Government whereof were become almost independent Sovereignities. *Astronomy*, *Mechanicks*, *Opticks*, *Chymistry*, &c. were distinct Sciences, and had nothing in common with that which is call'd *Physicks*, and even the Physicians themselves had separated from it their Philosophy, the Name alone of which betray'd it. *Physicks* being thus depauperated and stripp'd, had nothing belonging to it but Questions equally thorny and barren. Monsieur *Dubamel* therefore undertook to restore to this Science that which

which had been usurp'd from it ; that is to say, an infinite Number of useful and agreeable Knowledges, proper to revive that Esteem and Relish which was due to it. He began to execute this Design by his *Astronomia Physica*, and by his Treatise, *De Meteoris & Fossilibus*, both of 'em printed in the Year 1660.

These two Treatises are Dialogues ; the Speakers of which, are *Theophilus*, a great Admirer of the Ancients, *Menander*, a zealous *Cartesian*, and *Simplicius* a Philosopher, and an indifferent Man between all Parties, whose chiefest Task was to bring them all to an Agreement, and who moreover by Virtue of his Character, was to cull from all their Hypotheses such things as he judg'd the best. This *Simplicius*, or Monsieur *Dubamel*, is the same Person.

From the Form of his Dialogues, and his Manner of handling Philosophy, one may discover that *Cicero* was his Pattern ; but it is yet more obvious by the pure accurate Latinity of them, and which is yet more important, by the great Number of fine and ingenious Expressions that frequently occur in those Works, which are Philosophical Discourses divested of their Natural, or at least usual Driness, by passing thro' a rich and flowry Imagination ; from which, however, they have only borrow'd that just Dose of Agreeableness, which was necessary to set them off. Those things which are to be establish'd to a certain Degree only, are what always cost the most Pains.

His

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His *Physical Astronomy* is a Collection of the principal Thoughts of the Philosophers both ancient and Modern, upon Light, Colours, and upon the Systems of the World; and besides every thing that belongs to the Globe, to the Theory of Planets, and to the Calculation of Eclipses, are thereby Mathematically explain'd.

So likewise his *Treatise of Meteors and Fossils*, is a Collection of all that any Authors of some Reputation have writ upon those Matters; for Monsieur *Dubamel* did not confine himself to the most eminent. In his Discourse about *Fossils*, we may observe a great Knowledge of Natural History, and especially of Chymistry, tho' this latter Art was in those Times involv'd in Mysteries and Darknes, which could not easily be penetrated.

He has been reproach'd of being too severe upon the great *Descartes*, a Man so worthy of Respect from all the Philosophers, even such as do least agree with him. Indeed *Theophilus* does sometimes treat him severe enough, for which Monsieur *Dubamel's* Apology is, That the Part which *Theophilus* acted, was of a Person entirely partial to Antiquity, and incapable of any Modern Taste; but that *Simplicius* never treated him ill, and therein he said true, tho' at the Bottom, 'twas *Simplicius* that put Words into the Mouth of *Theophilus*.

In 1663, which was the same Year that he left his Living of *Neüllil*, he publish'd his famous Book, *De Consensu veteris & novæ Philosophiæ*. 'Tis a general Account of *Physicks*, or a *Treatise of First Principles*. What the Title promises,

is fully perform'd, and the Spirit of Reconciliation, hereditary to the Author, triumphs throughout the whole Work. He begins with the sublime and scarce intelligible Metaphysicks of the Platonicks, about Ideas, Numbers, and Architypical Forms; and tho' Monsieur *Duhamel* does acknowledge the Obscurity of them, yet he cannot refuse them a Place in this kind of *States-General* of Philosophy. He treats with the same Moderation the Principle of Privation, the Eduction of substantial Forms, and some other Scholastick Notions; but when he comes at last to those Principles that are to be understood, that is either to the Laws of Motion, or to the less simple Principles laid down by Chymists, one perceives, in spite of his Inclination to accommodate Matters among all Parties, he naturally lets the Scale turn on this Side. One may even perceive, that it is with Unwillingness he enters into those general Disputes, which in Effect are only about *Words*; the only Merit of which is, that they have a long time pass'd for *Things*. His Inclination and his Learning, upon those Occasions, do always hurry him back to Experimental Philosophy, and especially to Chymistry, in which he seems to have taken a particular Delight.

In 1666, Monsieur *Colbert*, who knew how much the Glory of Learning contributes to the Splendour of the State, propos'd to the King, and obtain'd his Majesty's Approbation for the Establishment of a *Royal Academy of Sciences*; and got together, with a singular Judgment, a small Number of Men; among whom, each one excelled in his kind: There was wanting to

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this Society, a Secretary, that could understand and readily speak all the different Languages of these learned Men, of a *Chymist* for Example, or of an *Astronomer*, &c. and such a one as might be their common Interpreter to the Publick, and that could give to so many thorny and abstracted Matters a Light, and a certain Turn, and even an Agreeableness too, which many Authors neglect, and yet which most Readers expect; finally such a one, who by his Character, was wholly free from Partiality, and fit to give a dis-interested Account of the Debates of that Academy. The Choice that Mr. *Colbert* made to perform that Function, fell upon Monsieur *Dubamel*; and indeed after the Proofs he had given without Design, of all those necessary Qualities, a Choice made by so judicious a Person, could not fall upon any other than him.

His Skill in the *Latin* Tongue having shin'd thro' all his Works, and become the more remarkable, as the Subject thereof was less favourable, he was chosen to translate into that Language, *A Discourse about the Rights of the late Queen upon Brabant, Namur, and some other Lordships of the Spanish Low-Countries.* The King, who caus'd it to be publish'd in the Year 1667, was desirous it might be read in all those Parts of *Europe* where his Conquests, and perhaps a great Number of excellent Books had not yet render'd the *French* Language so familiar as it is become since.

To this Work which supported the Rights of the Queen, there succeeded the next Year another by the same Hand, and in *Latin*, in Defence

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of those of the Archbishop of *Paris*, against the pretended Exemptions of the Abbot of *St. Germain des Prez*. 'Twas Monsieur *de Perefixe*, the then Archbishop, who engag'd Monsieur *Dubamel* in this Undertaking, believing, probably, that the Name of an Author, so averse from attacking any Body unjustly, that he would scarce strike the first Blow upon any Account whatever, would very much byass the World in Favour of the Archiepiscopal See. Indeed this was the only time that Monsieur *Dubamel* would be perswaded to do that Violence to his Character, as to act the Part of an Aggressor; and it was not amiss that he should act it once, to serve for a Model of that Moderation and good Breeding with which such sort of Disputes ought to be carried on.

The great Reputation of his Latinity, was the occasion that in the Year 1668, Monsieur *Colbert de Croissy*, Plenipotentiary for the Peace of *Aix la Chapelle*, took him along with him thither, where he often employ'd him in all those Businessess that were to be treated of in the *Latin* Languages with foreign Ministers; and tho' the Purity of the Language may appear to be a Circumstance of no great Moment, with respect to the Negociation of Peace, yet Politicians know very well that nothing should be neglected that can raise the Character of a Nation in the Eyes of its Neighbours or Enemies.

After the Peace of *Aix la Chapelle*, Monsieur *de Croissy* went Ambassador to *England*, and took Monsieur *Dubamel* with him. He made that Voyage as a Philosopher; his chief Curiosity was

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to see the Learned Men, and above all, the illustrious Mr. Boyle, who open'd to him all his Treasures of Experimental Philosophy. From thence he went into *Holland* for the same Purpose; and in those two Voyages he acquir'd the Riches with which he afterwards adorned his Books.

Being return'd to *France*, and in Possession of his Place of Secretary to the Academy, he publish'd his Treatise *De Corporum Affectionibus*, in the Year 1670. There he carry'd on his Philosophy as far as to the Knowledge of Medicines, and was not contented barely to touch upon the Principles of it; two Years afterwards he publish'd his Discourse, *De Mente Humana*, which is a *Metaphysical Logick*, or a Theory of Human Understanding, and of Idea's, with the Art of guiding our Reason: Now tho' Philosophical Experiments may seem to be foreign to this Subject, yet they are plentifully made use of by him, furnishing him with all the Examples he stood in need of; and he was so full of them, that they seem'd to overflow every Moment.

The next Year, that is to say in 1673, appeared his Book *De Corpore Animato*. One may easily judge by the Title, that Experimental Philosophy abounds every where in it, and so does Anatomy too, of which Monsieur *Dubamel* had acquir'd a great Knowledge both by the Conferences of the Academy, and by a particular Correspondence which he maintain'd with Monsieur *Steno* and *du Verney*. When Monsieur *du Verney* began to settle at *Paris*, and at the same Time establish'd a new Taste for Anatomy, Monsieur
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Dubamel was one of the first that laid hold upon him, and the Discoveries he brought with him. Such a Disciple spurred on the young Anatomist to a much greater Progress, and likewise contributed thereto.

In this Book *De Corpore Animato*, he takes Notice of his being reproached for leaving Disputes undetermin'd, and being too indifferent himself between all Parties, and promises to mend that Fault; but we must confess he does not seem to have kept his Word too much. It is a Fault however that few Philosophers are guilty of.

In the same Place, he charges himself with another Fault, and is much more concern'd at it; which was, that he being a Clergy-man, should sacrifice so much of his Time to profane Philosophy. It is easie to see that he could have justify'd himself with a Cloud of Reasons, but none of them did satisfy the extream Tenderness of his Conscience. He declares, that he will return to a Work of Divinity, of which he had form'd a Scheme from the very time of publishing his first Books, but that the Execution of it had always been prevented.

Notwithstanding which, he met with a new Interruption. A superior Command, and very honourable to him, oblig'd him to compose an entire Course of Philosophy, according to the Forms used in Colleges. This Work appear'd in 1678, under the Title of *Philosophia vetus & nova ad usum Scholæ accommodata in Regia Burgundiæ pertractata*: And is a Collection as judicious and happy as possible, of the ancient Ideas and of the new; of the Philosophy of Words,
and

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and of that of Things; of the Schools, and of the Academy. And to speak yet more justly of it, Measures are kept with the Schools, but the Academy predominates. *Monf. Dubamel* has dispersed throughout the whole Work all that he had gather'd in the Debates of the Society, Experiments, Discoveries, Reasonings, and Conjectures. The Success of the Work has been proportionably great; the new Systems in a manner disguised, or intermixed with the old, have been more easily admitted by the Enemies of them; and perhaps Truth it self has met with less opposition for being supported, as it were, by Error.

Several Years after the Publication of this Book, some Missionaries that carried it with them to the *East-Indies*, writ hither that they had taught that Philosophy with very good Success, particularly the Physicks, which among the four Parts of the entire Course, is that wherein the Academy and the Moderns are most concerned. People that were little instructed, and only guided by their natural Taste, did not long halt between the two Kinds of Philosophy, one of which has reigned so many Ages among us.

It looks as if *Monf. Dubamel* was doomed to be the Philosopher of the East. Father *Bouvet*, a Jesuit and famous Missionary of *China* writes, that when his Brethren and he composed in the *Tartarian* Language, a Body of Philosophy for the Emperor, and that vast State, in order to lead them by that means into the Truths of the Gospel, one of the chief Springs they made use of, was the Ancient and Modern Philosophy of *Monf. Dubamel*, who ought therefore to be comforted
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for the Pains he had taken about it; since it open'd a Way in those Countries for the admission of the Christian Religion.

At last however he discharged himself more punctually of the Duty he had laid upon himself; for in the Year 1691, he Published a Body of Divinity in Seven Tomes with the following Title, *Theologia Speculatrix & Practica Juxta SS. Patrum dogmata pertractata & ad usum Scholæ accommodata*. Divinity has been long filled with Subtilties which indeed were very ingenious, and even useful in some Degree; but very often too excessive; and at the same time, People neglected the Study of the Fathers, Councils, History of the Church, in a word all that they now call Positive Divinity; they went as far as they could go by the Metaphysicks alone, and without the help of Facts, almost wholly unknown, and this Divinity may be properly called the *Daughter of the Mind and of Ignorance*; but at last the more wholesom and more nice Views of the two last Ages, have made the Positive Divinity prevail. *Monf. Dubamel* in his Work has united it with that of the Schools, and no body was more fit to bring about this Re-union; for what Experimental Philosophy is, with respect to the Scholastick, the same is the Positive Divinity, with respect to the old School Divinity; 'tis the Positive that gives strength and solidity to the Scholastick, and *Monf. Dubamel* did exactly the same for Divinity as he had done for Philosophy; on one side and on the other we see the same extent of Knowledge, the same Inclinations, and the same Endeavours to reconcile Opinions, the same Judgment

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in chusing where it is necessary ; finally, the same Soul acting upon different Matters. One may therefore represent to ones self from this Work what it is to be a Philosopher and a Divine all at once ; a Philosopher embracing the whole Body of Philosophy, and a Divine taking in the whole Compass of Divinity.

This almost immense Labour engaged him in another. He was desired to make an Extract from his Body of Divinity of such things as were most necessary for young Clergymen whilst they were instructed in the Seminaries : Being sensible of the Usefulness of such a Design, he undertook it, tho' he was at that time Seventy Years old, and subject to an Infirmary which from time to time brought him to the brink of his Grave : Nay, he did more than was expected of him, for he treated of several Matters which were not at all in his First Work, and made it almost a New one, and published it in the Year 1694, under this Title ; *Theologia Clericorum seminariis accommodata summarium*. This Summary contains Five Volumes.

This Application to Divinity was no Interruption to his Academical Duties. He did not only continue in the Exercise of his Function as Secretary, and in registering the Transactions of every Meeting, but he also undertook to compose in Latin a general History of the Academy, from its Establishment in the Year 1666, down to the Year 1696. He made those Years the Period of his History, because he resigned his Office in 1697, having represented to Mons. Pontchartrain, Chancellor of *France*, that he was become so Infirm, as to stand in need of a Successor. It would be
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my Interest to conceal in this place the Name of the Person that durst succeed so great a Man, but the Obligations I lye under to him for his Goodness in approving, and his Care in forming me, will not allow it.

'Twas in the Year 1698, that his History appeared under this Title, *Regia Scientiarum Academia Historia*, the Edition was soon spent, and in 1701, there came out a Second much larger, being augmented with the four Years that were wanting to compleat the Century; the two last of which are comprehended in the *French Account* of the same.

If the Date of his Books were not an incontestable Proof, we could hardly be so bold as to assert, that in the same Year 1698, in which he published the First Edition of his History of the Academy; he also gave us a very Learned Theological Work entitled, *Institutiones Biblicæ, seu Scripturæ sacræ Prolegomena, unâ cum selectis Annotationibus in Pentateuchum*. In which he has collected all that is most necessary to be known in the Criticism of the Holy Scriptures; a sure and right Judgment is the Architect that chuses and disposes of the Materials which a vast Erudition supplies it with; the same Character reigns throughout the Notes upon the five Books of *Moses*, being concise and well chosen, instructive and only curious in order to instruct the better; Learned without Pomp, and intermingled sometimes with Sentiments of Piety, which proceeded as naturally out of the Heart of the Writer, as from the Subject it self.

In 1701. he published the *Psalms*, and in 1703. the *Proverbs*, *Wisdom of Solomon* and *Ecclesiastes*, with the like Notes; all these Treatises were only the Fore-runners of another vastly greater, upon which he was at work, that is, of the whole Bible, with Notes upon all those places that required it, and such Notes as he was able to give; this appeared in the Year 1705, when he was of the Age of 81. This Bible, both by the Beauty of the Edition, and by the Convenience and Usefulness of the Comment, placed at the bottom of every Page, does, in the opinion of the Learned, far exceed all those that have been yet published.

Being arrived to so great an Age, and having acquired a greater Right to a Glorious *Quietus* than any other whatever, but being incapable to live idle, he intended to have continued to turn into Latin the French *History of the Academy*, and he had already begun to Translate the general Preface, but was prevented by an easie and gentle Death, proceeding only from the bare Necessity of Dying, which happen'd upon the 6th of *August*, 1706.

Hitherto we have only described him as a Man of Learning and Member of the Royal Academy: We should now represent him as a Man, and give some account of his Morals, but to do that we must make the Panegyrick of a Saint; we are not therefore worthy to speak, upon this Part of his Elogium, which ought to be performed in a Church, and not in a Philosophical Meeting; we shall only hint at two Facts, that may be related by a Prophane Mouth.

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He went once a Year to visit his old Flock at *Neuilli* upon the *Marne*, and that Day was kept as a Festival throughout the whole Village; nobody would work, and they were wholly taken up with the Pleasure of seeing him. All the World knows what are the Virtues, not only Moral but Christian, necessary to make a good Pastor, and to procure him so great an Ascendant over the Hearts of his People, and of what value are the Praises of those over whom one has had an Authority once, but has none any longer.

Whilst he was in *England*, the *English* Catholics which used to frequent the Chapel of the *French* Ambassador would commonly say, *Let us hear Mass from the Holy Priest.* These Foreigners did not want a long time to form such a Notion of him as he deserved; an external Simplicity, and which he could not be supposed to affect, discover'd his internal Virtues, and betrayed the Desire he had of concealing them: It was easie to perceive that his Humility did not consist in Words and Discourses, but in his real Sentiments, and was founded even upon his Learning; and his Charity was too often exerted not to be, in spite of all his Precautions, very plain and visible; the general Desire he had of being useful to others was so well known, that the favourable Characters he gave of Persons, lost part of their just weight, because they came from him.

Cardinal *Anthony Barberin*, great Almoner of *France*, made him one of the King's Chaplains in the Year 1656, which we had forgot to take notice of, tho' it is a Circumstance that ought not to have been omitted in the Life of any other Person.

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He was all his time in great Esteem with the Chiefest of our Prelates : Notwithstanding which, he was never possessed of any but very small Benefices, which still helps to illustrate his Character ; for the last Stroak of which, I shall add, that he never was possessed of any whereof he did not divest himself for the sake of somebody or other.

The Office of Pensioner *Anatomist* which he enjoyed in the Academy, has been filled by Monsieur *Littre* ; and that of *Associate Anatomist* enjoyed by *Monf. Littre*, was given to *Monf. du Vorney* the Younger, who was *Monf. Dubamel's Pupil*.



The LIFE of Monsieur REGIS.

 *Eter Silvan Regis* was born in the Year 1632, at *La Salvetat de Blanquefort* in the *Agenois*. His Father was in very good Circumstances, and liv'd to the top of 'em ; but as he had a great many Children, so he left but a very small Fortune to our *Monf. Regis*, who was one of the Youngest.

After having with Reputation gone thro' the Studies of Humanity and Philosophy in the *Jesuits College* at *Cabors*, he apply'd himself to Divinity in the University of *Paris*, being designed for a Clergyman ; and he became so great a Master of it in four Year's time, that the Body of the University solicited him to take his Doctor's Degree, offering to bear the Expence of it themselves. But he did not think himself worthy of it till he

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had studied in the *Sorbonne* : Thither he went, but being disgusted at the excessive tediousness of that which was dictated to him by a famous Professor, only upon the Question of the Time when the *Eucharist* was instituted, and being taken with the *Cartesian Philosophy*, which he just then began to know by his Conversation with *Monf. Robaut*, he abandon'd himself wholly to that Philosophy, the Charms of which, abstracted even from its Novelty, could not fail to become very agreeable to such a Genius as his. He had not above four or five Months to stay at *Paris*, so that he made hast to be instructed by *Monf. Robaut*, who on his Side, being zealous for his Doctrine, took a great deal of pains with a Disciple whom he found so fit to propagate it.

Monf. Regis having left *Paris* with a kind of a Mission from his Master, went to establish his new Philosophy at *Toulouse*, by Publick Lectures which he set up in the Year 1665. He had an agreeable Facility in Speaking, and the Gift of bringing down the most abstract Matters to the Capacity of his Hearers. The whole Town being presently alarm'd by our new Philosopher, the Magistrates, Clergymen, and all the Learned ran to hear him, even the Ladies themselves made part of the Auditory ; and if any one ought to share with him the Glory of this great Success, it was at least none but the illustrious *Descartes*, whose Discoveries he preached up.

There was a Thesis maintained of pure *Cartesianism* in *French*, Dedicated to one of the first Ladies of *Toulouse*, whom *Monf. Regis* had made a very able *Cartesian*, and he himself presided at
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that Thesis. The Parties disputed in *French*, and the Lady her self solved several considerable Difficulties, and it seemed as if People, affected by all these Circumstances, had resolved entirely to abjure the ancient Philosophy.

The Magistrates of *Toulouse* being very sensible of the Instructions and Lights that *Monf. Regis* had brought to them, settled him a Pension upon the Town-House, a Thing almost incredible in our Age, and Glorious enough for the old *Grecians* and *Romans*.

The Marquis *de Vardes*, at that Time banished into *Languedoc*, being come to *Toulouse*, and presently acquainted with *Monf. Regis*, got leave of the Town, but not without Importunity, to carry him along with him to his Government of *Aigues-mortes*, where he strictly united him to himself by his own Merit, and by the Esteem and Friendship, which is for the Glory both of the one and of the other; he had no occasion to engage him by those other means that commonly pass for the most efficacious. He endeavoured to employ, or rather to amuse, himself with him in the *Cartesian* Philosophy; and as his Wit had made him shine in a Court that knew how to Judge of it, perhaps the Philosopher did not less profit by the Conversation of the Courtier, than the Courtier by that of the Philosopher, each of these two different Characters being usually composed of that which is wanting in the other.

The Marquis *de Vardes* went to *Montpellier* in the Year 1671, and *Monf. Regis*, who accompanied him thither, read Lectures in that City, with the same Applause he had done at *Toulouse*.

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BUT all great Talents must finally center in the Capital, whither *Monf. Regis* came in the Year 1680, and began to hold the same Lectures in the House of *Monf. Lemery*, at present one of the Members of the Academy. The Concourse of People was quickly so great, that it became too inconvenient for the House of a private Person: Places were taken a great while before the Hour appointed for the Lecture, and perhaps the Severity of this History does not forbid me to observe, that the most agreeable Actor of the *Italian* Play-House, (who when he was off of the Stage, conceal'd the serious Spirit of a Philosopher, under a Mask of an inimitable *Badinage*) was seen to frequent those Lectures daily.

'Tis a Fault to succeed too well: The Lectures of *Monf. Regis* made such a Noise, as became fatal to them. The late Archbishop of *Paris*, out of the Respect he paid to the Ancient Philosophy, sent him an Order to suspend them, disguis'd under the Form of an Advice or Request, and sweeten'd with a great many Commendations. Thus the Publick were depriv'd of these Meetings at the End of six Months, and in the Middle of their most lively Relish for them; and so perhaps, tho' without Design, their Inconstancy was obviated, and their Esteem increas'd for what they had lost.

Monf. Regis being now more free, employ'd all his Thoughts about publishing a general System of Philosophy which he had compos'd, and which was the principal Occasion of his Journey to *Paris*. But this Design was likewise cross'd during the Space of ten Years; at last, with the Assistance

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Assistance of Time and Reason, he overcame all Oppositions, and the Work appear'd in the Year 1690 under this Title, *A System of Philosophy, containing Logick, Metaphysicks, Physicks, and Morality*, in three Vols. in 4to.

The Advantage of a general System is, that it furnishes the Mind with a more pompous Spectacle, which always delights to look down from a greater Eminency, and to discover a larger Extent of Country; but on the other Hand, it is an Evil without Remedy, that Objects view'd at a farther Distance, and in a greater Number, are generally most confused. Different Parts are link'd together, for the Composition of a whole, and mutually strengthen'd by such a Union; but then each of them are handled in particular with less Care, and suffer by being a Part of one general System. One single Subject well explain'd, might perhaps satisfy as well, without reckoning that as soon as ever it was well explain'd, it would always become general enough; if one considers the Glory of the Author, there remains no more to one that undertakes such a Work, but that of a judicious Compilation, and tho' like *Monf. Regis*, he might add to it several new Idea's, the Publick will not take the Pains to distinguish them from the rest.

Engaged as he was to defend the *Cartesian* Philosophy, he published in the Year 1691, an Answer to the Book entitled, *Censura Philosophiæ Cartesianæ*, writ by one of the most learned Hands of *Europe*; and the late *Mr. Boyle*, a very good Judge, having seen the Answer, was of Opinion, that it might serve for a Pattern to all that
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should be undertaken for the Future in the same Cause. The following Year, *Monf. Regis* defended himself against a Learned Professor of Philosophy, who had attacked his general System. These two Answers which he thought himself obliged to give in a very little time, and an Augmentation of more than a third Part, which he had just before made to his System at the very time he was perusing it, were the Occasion of his falling into those Infirmities that grew upon him ever after. Thus Philosophy it self has its Passions and Excesses that cannot escape unpunished.

Monf. Regis was embarked in yet greater Disputes, on account of his having attacked in his *Physicks*, the Reason that Father *Mallebranche* had given in his *Search after Truth*, why the Moon appears bigger at the *Horizon* than it does at the *Meridian*? They writ on both Sides, and the chief Question was reduced between 'em to this Point, Whether the apparent greatness of an Object depended solely on the greatness of its Image painted on the *Retina*, or on the real greatness thereof, and the Natural Judgment which the Soul makes of its Distance, insomuch, that all the rest being equal, she ought to see it so much the larger as she judges it more remote? *Monf. Regis* asserted the former; Father *Mallebranche* the latter, and maintained, that a Giant six Foot higher than a Dwarf, and placed at the distance of twelve Foot, would nevertheless appear higher than the Dwarf that was placed but two Foot off, in spite of the equality of the Images which they both formed in the Eye; the reason of which was, one sees the Giant as more remote on account of the Interposition of different

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Objects: He would not even allow to *Monf. Regis*, that the Intage of the Moon at the Horizon was augmented by the Refractions, at least in the manner it ought to be for this Phenomenon, and he added different Experiments, by which the Moon ceased to appear larger, as soon as it was seen in such a Way as not to be esteemed more remote. *Monf. Regis* however maintained his Opinion, and as Authors, according to the custom of all Disputes, do multiply their Writings sometimes very unnecessarily; *Father Mallebranche* thought he had a Right to determine the Question by way of Authority; but it was such an Authority as might be made use of in the Way of Learning. He procured a Certificate of Four of the most famous Geometricians, who declared, that *the Proofs he had brought of his Sentiment were Demonstrative, and plainly to be deduced from the true Principles of Opticks*. The Geometricians were the late *Marquis de L'Hopital*, the *Abbot Catelan*, *Monsieur Sauveur* and *Monf. Varignon*. *Monf. Regis* upon this Occasion acted according to the first Suggestions of Nature, and endeavour'd to find fault with each of those Gentlemen. The *Journal des Scavans* of the Year 1664, was the Theatre of this War.

It was likewise so, at least in part, of another War between the same Adversaries: *Monf. Regis* in his Metaphysics, had often fallen foul upon those of *Father Mallebranche*: One of their chief Disputes turned upon the Nature of Idea's, upon their Cause, whether Efficient, or Exemplary; a Subject so sublime and abstracted, that tho' the Mind of Man cannot discover a sufficient Certainty

in it, yet it is Glory enough to have arrived at well-grounded or reasonable Doubts. The two Metaphysicians debated likewise, whether *Pleasure does render us actually happy*, and they were as much divided upon this Question, tho' it be less Metaphysical. As the Works of Father *Mallebranche* had acquired him several able and zealous Disciples, some of them writ also against *Monf. Regis*, who contented himself in having enter'd the Lists with their Master.

The Inclination which he always preserved for Divinity, and his Love of Religion, inspired him with another Undertaking already attempted many times by great Men, worthy of all their Efforts, and of their wisest Ambition, and more necessary than ever, in so enlighten'd an Age as that we live in. He finished it in the Year 1704, in spite of his continual Infirmities, and published it under this Title in a Quarto Book; *The Use of Reason and Faith, or the Agreement of Faith and Reason*. He dedicated it to the Abbot *Bignon*, to whom he says in his Epistle, *that he could not cite the Enemies either of Reason or of Faith before a Judge to whom the Rights of the one and the other were better known; and that if they refused him, the only reason would be, because he had already so highly declared himself in favour both of Faith and Reason*. The Method he takes to bring about so difficult an Agreement, is that which a wise Arbitrator would make use of with respect to two Brothers, between whom he was desirous to stifle all the Seeds of Division. *Monf. Regis* distinguishes so nicely between *Reason* and *Faith*, and assigns to each of them Objects and Employments

so different, that they can never have again, as I may say, any occasion of Embroiling themselves together. Reason leads Man even to an entire Conviction of the Historical Proofs of the Christian Religion ; after which she abandons and delivers him up to another Light, not contrary, but quite different and infinitely superior. The Distance which *Monf. Regis* makes Reason and Faith keep between themselves, does not permit them to re-unite in the Systems which accommodate the Idea's of some prevailing Philosopher to *Revelation*, or sometimes even *Revelation* to his Idea's. He will not allow that either *Plato* or *Aristotle*, or *Descartes* himself, support the Gospel ; He seems to be of Opinion, that all the Philosophical Systems are no more than Modes, and that Eternal Truths must not be allied with the fleeting Fancies, the Ruin of which ought to be indifferent to a Christian ; that we ought to keep to the Majestick Simplicity of the Councils, which always decide Divine Opinions, without intermixing any Humane Explanations. Such is the general Spirit of the Work, at least with respect to the Title, for *Monf. Regis* blends with it a Theory of the Faculties of Man, of the *Understanding*, *Will*, &c. more largely than was absolutely necessary. He even concludes it with a Treatise of the Love of God ; because that Matter, which if Men pleased, might be very plain and simple, was handled by great Doctors with much Subtilty ; Lastly, he joyns to the whole Book a Refutation of the System of *Spinoza*. He found himself obliged to lay open its Obscurities, which indeed were necessary to hide Error, but happily very unfit to seduce

duce Men. Here he finished his learned Career; his Infirmities, that became more lasting and more painful, would not suffer him to labour any longer; the manner in which he supported them for several Years, was an instance of the most noble and most difficult Use that one can make of *Reason* and *Faith* both together. He died the 11th of *Jan.* 1707. at the House of the Duke of *Roban*, who had given him an Apartment in it; besides the Pension that he was obliged to pay him, pursuant to the Will of the Marquis *de Vardes*, his Father-in-Law.

He was chose into the Academy in the Year 1699, upon the Re-establishment thereof; but by reason of his Infirmities, he scarce performed any Academical Function, only his Name served to adorn a List in which the Publick would have been surpris'd not to have found him.

He had all his Life-time a large Correspondence with People of the first Quality. The late Archbishop of *Paris* at the same time that he forbid him holding of Lectures, engaged him to come to his House upon certain Days to discourse with him about the same Matters; and perhaps it was a greater Honour to *Monf. Regis*, that so Learned a Prelate should substitute himself to the Publick. The late Prince who had a Genius for every thing, sent often for him, and used to say, that he could not forbear believing what he explained so clearly.

His Reputation extended it self into Foreign Countries, where it procured him Friends among the greatest Personages, such was the *Duke of Escalona*, a Grandee of *Spain*, and Viceroy of *Naples*. That Nobleman, more Curious and more affected

with the Sciences than the rest of his Nation are as yet, had conceived a singular Esteem for him on occasion of his general System, which he had carefully studied; and when at the Battel of the *Ter* in the Year 1694, where he commanded the Spanish Army, his Equipage was taken by the Army of the *Mareschal de Noailles*, he only desired back again *Cesar's Commentaries*, and the Book of *Monsieur Regis*, which he kept in a little Trunk. The Count of *Sant Estevan de Gormas*, the Son of that Duke, coming into *France* in the Year 1706, waited upon this Philosopher by Order of his Father; but after the first Visit, it was no longer out of Obedience that he frequented his Company. The Duke of *Alva*, Ambassador of his Catholick Majesty, did him the same Honour, at the Request of the Viceroy of *Naples*.

The Manners of *Monsieur Regis* were such, as the Study of Philosophy might form, when it meets not with too much Resistance on the side of Nature. The Opportunities that he had with respect to Fortune, were of as little use to him as they ought to be, and a great Esteem, and a hearty Friendship, which the late Father *Ferrier*, the King's Confessor, had conceived for him at *Toulouse* during his Lectures there, was of no more advantage to him, than only to procure him a moderate Pension. Tho' he had been used to Teach, yet his Conversation was not the more imperious for it, but rather more easie and plain, having been accustomed to adapt himself to the Capacity of all his Hearers. His Learning did not render him Haughty to the Ignorant; and indeed the more learned a Man is, the greater Complai-

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Complaiſance he has for ſuch Perſons, being thereby the more convinced that he ſtill reſembles them.

His Place of *Associate Geometrician* was fill'd by *Monſ. Chevalier*, who before had been *Pupil* of the *Abbot Gallois*.



The LIFE of the Mareſchal de VAUBAN.

SEbastian le Preſtre, Chevalier and Seigneur de Vauban, Mareſchal of France, Knight of the Orders of the King, Commiſſary-General of the Fortifications, Grand-Croix of the Order of St. Lewis, and Governour of the Citadel of Liſle, was born the 1ſt of May, 1633. His Father's Name was *Urban le Preſtre*, and his Mother's *Amy de Carmagnol*. He was of a good Family in the *Nivernois*, which had been in poſſeſſion of the Lordſhip of *Vauban* for above 250 Years.

His Father, who was but a younger Brother, and who moreover had ruined himſelf in the Service, left him no other Fortune than a good Education and a Muſquet. At the Age of 17 Years, that is to ſay in 1650, he enter'd into the Regiment of *Conde*, at which time that Prince was engaged in the *Spaniſh* Party.

The firſt fortified places he ſaw made him an Engineer, from the longing he had to become ſo. He applied himſelf diligently to the Study of Geometry, and principally of Trigonometry, and of Meaſuring or Surveying; and about the Year 1652,

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he was employ'd in the Fortifications of *Clermont* in *Lorain*. The ſame Year he ſerved at the Siege of *St. Menebout*, where he made ſome Lodgments, and ſwam over the River, the Enemy firing at him all the time; an Action that procured him a great many Praises and Careſſes from his Superiors.

In 1653, he was taken Priſoner by a Party of the *French*; and Cardinal *Mazarine* thought it worth the while even at that time to engage him in the Service of the King: But there was no need of taking much pains with a Man that was born the moſt faithful Subject in the World. In this ſame Year *Monſ. de Vauban* ſerv'd as Second Engineer under the Chevalier *de Clerville*, at the ſecond Siege of *Menebout*, which was re-taken by the King, and the Care of repairing the Fortifications of the place was committed to him.

In the following Years he performed the Function of Engineer at the Sieges of *Stenay*, *Clermont*, *Landrecy*, *Conde*, *St. Guillain* and *Valenciennes*. He was dangerously wounded at *Stenay* and *Valenciennes*, which ſcarce hinder'd him from continuing his Service. He receiv'd 3 Wounds at the Siege of *Montmedy* in 1657; and as the Gazette took notice of it, his Friends learnt from thence what was become of him; for in fix Years time he neither return'd into his Country, nor writ to any one; ſo that this was the only way of communicating the News of himſelf. The Mareſchal *de la Ferté*, under whom he then ſerv'd, and who the Year before had made him a preſent of a Company in his Regiment, gave him one more in another Regiment, in the place of a Penſion; and then foretold aloud, that if the War ſpared him, he would attain to ſome of the higheſt Dignities. In

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In 1658, he had the chief Direction of the Attacks at the Sieges of *Gravelines*, *Tpres* and *Oudenard*. Cardinal *Mazarine*, who never uſed to gratifie People for nothing, gave him a handsome Reward, and accompanied it with Praises, which to a Man of *Monſ. Vauban's* Temper, was of much greater value than the Gift it ſelf.

It is enough for us to have been thus particular in his firſt Beginnings, which were ſo much the more remarkable than all the reſt in an illuſtrious Life, as Virtue ſtript of all foreign Aſſiſtance, was the more put to its Shifts to make its own way. From hence forwards *Monſ. de Vauban* is well known, and his Hiſtory is interwoven with that of *France*.

After the *Pyrenæan* Treaty, he was employ'd either in demolishing, or in making fortified places.

He had already a great number of new Notions about the Art of Fortifications, which at that time was but little known: Thoſe who had practiſed it, or writ about it, had ſervilely tied themſelves down to certain Rules, eſtabliſh'd indeed, but very ill grounded, and to certain kinds of Superſtitions, which are always a long time predominant in every Profeſſion, and only vaniſh at the preſence of ſome ſuperior Genius. Beſides, they had either ſeen no Sieges at all, or not enough; ſo that their Methods of Fortifying were only calculated for certain particular Caſes that fell under their cognizance, but did not extend themſelves to the reſt. *Monſieur de Vauban* had already ſeen a great deal, and with good Eyes; he continually enlarg'd his Experience by reading all that was writ upon the Art of War; he felt in himſelf that which produces happy Novelties,

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velties, or rather ſuch an Impulſe as forces the Production of them; in a word, he had the courage to declare himſelf an Inventer in ſuch a dangerous matter, and he continued ſo to the end. We ſhall not enter into the Detail of his Inventions, becauſe it would ſwell our Diſcourſe too much, beſides all the ſtrong places in the Kingdom may ſpare us that labour. •

When the War broke out again in the Year 1667, he had the Conduct of all thoſe Sieges which the King made in Perſon, his Majeſty being willing to let the World ſee that it was an effect of his Prudence to ſecure in that manner the Succeſs of them. At the Siege of *Douay* he received a Muſquet-shot in his Cheek, of which he has ever ſince worn the Mark. After the Siege of *Liſle*, which he took, under the King's Directions, in nine Days, from the time of opening the Trenches, he received a conſiderable Gratification, much more neceſſary to ſatiſſie the Inclination of the Maſter than that of the Servant. He has had a great many more upon different Occaſions, and always larger; but that we may the better enter into his Character, we ſhall ſay no more of this kind of Rewards, of which he was hardly ſenſible at all.

In 1668, he was taken up with projecting Fortifications for the places of the *Franche-Conté*, *Flanders* and *Artois*. The King gave him the Government of the Citadel of *Liſle*, which he had made, and this was the firſt Government of that nature in *France*. He did not ask it, and it is for the Glory of the King, as well as for his Honour, that the World ſhould know, that of all the Favours he ever receiv'd, he did not beg one, excepting ſuch

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as were not for himſelf. 'Tis true the number of theſe latter were ſo great, that they almoſt exhausted the Right he had to aſk them.

The Peace of *Aix la Chapelle* being made, his Employment did not become the leſs for it: He fortified ſeveral places in *Flanders*, *Artois*, *Provence* and *Rouſſillon*, or at leaſt made Plans of them, which have ſince been put in execution. Afterwards he went into *Piedmont* with *Monſ. de Louvois*, and communicated to the Duke of *Savoy* Plans for the Fortification of *Verue*, *Vercel*, and *Turin*. At his Departure his Royal Highneſs beſtowed upon him his Picture ſet with Diamonds. He is the only Military Man to whom Peace has always been as laborious as the War it ſelf.

Altho' he was not obliged by his Employment to take care of any thing more than the Security of the Frontiers, yet his Love for his Country made him apply himſelf to find out Means for increaſing the Happineſs thereof. In all his Travels he had the Curioſity, which thoſe who are in Offices are uſually but too much exempted from: He carefully inform'd himſelf of the Value of the Lands, of their Productions, of the manner of Cultivating them, of the Riches and Number of the Peaſants, of the accuſtmary Food, and what their Labour might amount to one Day with another; Circumſtances mean and contemptible in appearance, but which neceſſarily belong to the great Art of Government; then he ſet himſelf to conſider of Methods to improve a Country, of the High-ways, of Bridges, of making Rivers navigable, &c. Projects, of which it was not poſſible for him to expect an entire Execution, and therefore might in ſome

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ſome ſenſe he counted Dreams, but at leaſt ſuch as like real Dreams diſcover'd the Predominant Inclination of the Man. There are ſome Intendants or Governours of Provinces with whom he had not the leaſt Acquaintance; notwithſtanding which, he ſent them Letters of Thanks for ſome New and profitable Eſtabliſhment, which he had obſerved in their Diſtricts; thus he became the particular Debtor to every one that had obliged the Publick.

The War which began in 1672, furniſhed him with a vaſt number of glorious Opportunities, particularly in the many Sieges made by the King in Perſon, and of all which Monſ. *Vauban* had the Direction. 'Twas at that of *Maeftricht* in the following Year, that he began to make uſe of a new Method, which he had invented by a long Series of Reflections, and which he has ever ſince practiſed in the Attack of Places. 'Till then he had only followed, but with more Skill and Management, the Rules already laid down, but then he followed unknown ones, whereby he changed the face of this important Branch of making War. The famous Parallels and Places of Arms firſt appeared here; ſince when he has been always improving this Subject, one while by *Cavaliers de Tranchée*, another time by a new uſe of Saps and Demi-saps, then by Batteries *en ricochet*, by which means he brought his Art to ſuch a Perfection, that often-times he loſt no more People before the ſtrongeſt places than the Beſieged themſelves; a Thing which one could never have expected. Indeed the Preſervation of his Men was his chiefſt Care, not only the Intereſt of War, but even his
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own Natural Humanity and Goodneſs made them dear to him. 'Twas to this Conſideration that he always ſacrificed the Splendour of a ſpeedy Conqueſt, and a Glory ſufficiently capable of ſeducing a Man; and what was yet more difficult, he ſometimes reſiſted, for the ſake of his Men, the Impatience and Uneaſineſs of the Generals, and expoſed himſelf to the Formidable Cenſures of the Lazy Courtiers. This made the Soldiers obey him with an implicit Devotion, being yet leſs encouraged by the entire Confidence they had of his Capacity, than by the Assurance, and Gratitude for being ſpared as much as poſſible.

During that whole War which was determined by the Peace of *Nimeguen*, his Life was one continual and vigorous Action, employed in Projecting Sieges, Directing thoſe that were formed, at leaſt the moſt Important ones, Repairing places that were taken, and making them Stronger; Viſiting all the Frontiers; Fortifying whatever might be expoſed to the Enemy, paſſing from one Army to another, and oftentimes from one End of the Kingdom to the other.

He was made Brigadier of the Foot in 1674, Mareſchal de Camp in 1676, and Commiſſary-General of the Fortifications of *France* in 1678; which laſt Office became then vacant by the Death of the Chevalier *Clerville*. He declined taking it at firſt, fearing that which would have render'd it more deſirable to another, the great Relation that it gave him to the Miniſtry; but the King made uſe of his Authority to oblige him to accept of it; but it muſt be confeſſed, that notwithſtanding all his Integrity, he had no reaſon to Re-
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pent of it. Virtue does not fail to ſucceed ſometimes, but it is only by length of Time, and by the weight of many Trials.

The Peace of *Nimeguen* deprived him of the troubleſome Employment of taking Places, but in ſtead of that, it afforded him a much greater number to be fortified. He made the famous Port of *Dunkirk*, and it was his Maſter-piece. *Strasburg* and *Casal*, that fell into the King's hands in 1681, were after that his moſt conſiderable Buſineſs. Beſides the vaſt and magnificent Fortifications of *Strasburg*, he made the little River *Bruche* Navigable by Sluices; the Execution of which was ſo difficult, that he durſt not truſt it to any body, but always ſuperviſed himſelf.

The War broke out again in 1683, and gave him the Honour of taking *Luxembourg* in the following Year, which 'till then was thought Impregnable; but he took it with very little Loſs. But the dawning War having been ſtified by the Truce of 1684, he reſumed his Functions of Peace, the moſt ſhining of which were the *Aqueduct* of *Maintenon*, the New Works that compleated the Canal for the Communication of the two Seas, and thoſe of *Mont-Royal* and *Landau*.

One would think that the Secrets of his Art muſt have been diſcover'd by the great Number of Works that came out of his Hands: And ſo indeed there did appear a Book, the Title of which promiſed the true Method of Fortifying according to *Monſieur Vauban*; but he always affirmed, and has ſhewn it by his Practice, that he had no One Method at all. Every different Place furniſhed him with a new Manner; according to the different

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rent Circumſtances of its Bigneſs, Situation and Soil. The moſt difficult of all the Arts are thoſe whoſe Objects are always variable, and which cannot endure the convenient Application of certain fixed Rules by Men of a narrow Genius, but every Moment require Natural and Extempore Expedients, which can only flow from great Souls.

The War being re-kindled in 1688, he directed the Sieges of *Philipsbourg*, *Manheim* and *Frankendal*, under the Command of the *Dauphin*; and that great Prince was ſo well pleaſed with his Services, that he gave him the Choice of four Pieces of Cannon for his Caſtle of *Bazoeche*; a true Military Recompence, and a Singular Privilege, which could ſo juſtly belong to none elſe but to the Father of ſo many ſtrong Places. The ſame Year he was made Lieutenant-General; and the next Year he Commanded at *Dunkirk*, *Bergues*, and *Ypres*.

The Year 1690, was a very Singular one among all thoſe of his Life, for he hardly did any thing in it, having contracted a great and dangerous Illneſs whiſt he was labouring in the Fortifications of *Ypres*, which were very much out of Order, ſo that he was obliged to be always preſent at the Works; but this Inaction, which he could ſcarce forbear reproaching himſelf with, determined in 1691, by the taking of *Mons*, at the Siege whereof the King commanded in Perſon; as His Majeſty did the following Year at that of *Namur*, and *Monſ. de Vauban* had the Direction of it, and took it in 30 Days after opening the Trenches, with the loſs only of 800 Men, tho' there had paſſ'd five very vigorous Actions.

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We muſt omit a great number of leſſer Exploits, ſuch as the Siege of *Charleroy* in 1693 ; the Defence of the Lower *Britany* againſt the Deſcent of the Enemies in 1694 and 1695 ; the Siege of *Aeth* in 1697, and make haſt to thoſe things that more nearly concern the Academy. When that Body was revived in the Year 1699, they beſought his Maſteſty to make *Monſieur de Vauban* one of their Honorary Members ; and if Decency would allow us to ſay that a Place in that Body may be accounted a Reward for Merit, after all thoſe he had received from the King in the Quality of a Military Man, it was neceſſary he ſhould receive one from a Society of Learned Perſons in the Quality of a *Mathematician*. No body had more effectually than he brought down from Heaven the Science of the Mathematicks, to employ them in the Wants of Mankind, and they had receiv'd from his hands an Uſefulneſs as glorious, perhaps, as their greateſt Sublimity. Beſides, the Academy owed him a particular Acknowledgment for the Eſteem he had always ſhewn to them ; the ſolid Advantages which the Publick may one day reap from our Eſtabliſhment, had touched him in the moſt ſenſible part of his Soul.

As after the Peace of *Ryſwick*, he was only employ'd in viſiting the Frontiers, in making the Tour of the Kingdom, and in forming new Projects ; he found that he ſtill wanted ſome more Buſineſs, and he embark'd himſelf in one that was according to his own Heart. He began it, by reducing into Writing a prodigious number of Notions that he gather'd together upon the different Subjects which relate to the Good of the Commonwealth : Not only

only upon thoſe that were moſt familiar to him, ſuch as the Fortifications, and other Circumſtances of Places, Military Diſcipline, Campings, &c. but likewise upon an Infinity of other Matters which one would have imagined to have been much more out of his Way, ſuch as relate to the Sea, to the Privateering in Time of War, to the Customs and Taxes, to the Improvement of Foreſts, Trade and the French Colonies in *America*. A great Soul thinks of every thing. From all theſe different Idea's he compoſed 12 great Manuscript Volumes, which he calls *Idle Hours*; but if it were poſſible that all his Projects could be put in execution, his *Idle Hours* would be much more uſeful than all his *Labours*.

The Succeſſion to the Crown of *Spain*, having renewed the War, he was ſent to *Namur* in the beginning of the Year 1703, and gave Orders for the neceſſary Reparations of that Place; it was then that the King had honour'd him with the Title of Mareſchal of *France*, which he himſelf had oppoſed before, when his Maſteſty had ſignified to him his Intentions of raiſing him to this higheſt Degree of Military Honour; having repreſented that it might hinder his being employed with Generals of the ſame Rank, and occaſion ſome Inconveniencies in the Publick Service. His Ambition was to become more Uſeful, and leſs Rewarded; and if it had been according to his own Mind, the only Recompence of his paſt Services, would be to employ him in ſuch as were yet more neceſſary.

About the end of the ſame Year he ſerved under the Duke of *Burgundy* at the Siege of Old
G *Briſac*,

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Briſac, a very conſiderable Place, but which he obliged to Capitulate at the end of thirteen Days and a half after the Trenches were open'd, and at the expence of 300 Men only. This Siege was his laſt Labour, and here he ſhew'd all that his Art could do; as if he had a Mind to reſign it whole and entire into the Hands of that Prince, who was both his Spectator and Commander.

The Title of Mareſchal of *France* did produce the Inconveniencies which he had foreſeen, and made him live uſeleſs two Years together. I have often heard him lament it, proteſting that for the Sake of his King and Country he could have trampled under his Foot that Dignity with pleaſure; and he would have done it too, if he might; this was the Beſt Way of meriting it, the beſt Way of ſupporting the true Luſtre of it.

He comforted himſelf however with his learned Idleneſs, ſparing no Expence in Collecting a vaſt number of ſuch Memoirs and Inſtructions as he wanted, and employing continually a great many Clerks, Limners, or Deſigners, and Arithmeticians.

He gave the King, in the Year 1704, a great Manuſcript which contained the moſt valuable and ſecret Rules for managing Sieges, the moſt noble Preſent that a Subject could ever make his Maſter, and which the Maſter could only receive from ſuch a Subject.

In 1706, after the Battel of *Ramelies*, the Mareſchal de *Vauban* was ſent to Command at *Dunkirk*, and all along the Coaſt of *Flanders*, where his Preſence did ſo much encourage the dejected People, that he ſaved the Loſs of a Country which

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which they were going to drown, to prevent the Siege of *Dunkirk*, which he likewise ſaved by a retrenched Encampment he made between that Town and *Bergues*, ſo that the Enemy would have been obliged to have inveſted at the ſame time *Dunkirk*, *Bergues* and his Camp; a thing wholly impracticable.

In this ſame Campaign, ſeveral of our Places not having defended themſelves ſo well as he could have wiſhed, he reſolved to defend by his Advice all thoſe that might be attacked for the Future. Upon this Occaſion he began a Work that he deſigned for the King, but did not live to finiſh it quite, for he died the 30th of *March* 1707, of a great Defluxion upon his Breſt, attended with a violent Fever, which carried him off in eight Days time, tho' he was of ſo Robuſt a Conſtitution that he ſeemed likely to live ſeveral Years longer. He was 74 Years old within a Month.

He married *Jane Danois*, of the Family of the Barons of *Eſpiri* in the *Nivernois*; ſhe died before him, leaving two Daughters, the Counteſs of *Villebertin* and the Marchioneſs of *Uſſé*.

If you would ſee his whole Military Life in Miniture, take it thus : He Fortified Three hundred Old Places, and made Thirty three quite New; He Directed Fifty three Sieges, Thirty of which were made under the Command of the King in Perſon, or of the Duke of Orleans, or of the Duke of Burgundy; and the other Twenty three under different Generals : He was preſent at 140 Engagements.

Never were the Traces or Features of a plain and ſimple Nature more remarkable in any Man than

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in him, nor more free from any Foreign Mixture. An enlarged and upright Mind, which embraced Truth by a Kind of Sympathy, and diſcovered Falſhood without any Diſcuſſion, ſaved him thoſe long Deviations that others were forced to make; and beſides, his Nature was in ſome fort a happy Inſtinct, and always ſo much at hand, that it got the ſtart of his Reaſon. He deſpiſed that ſuperficial Politenefs with which the World is generally contented, tho' it often conceals a great deal of Roughneſs; but his Goodneſs, Humanity and Generoſity, were the Ingredients of a more uncommon Politenefs, and which reſided altogether in his Heart. It well enough became ſo many Virtues to neglect an out-ſide, which indeed does naturally belong to them, but which Vice does too often and too eaſily aſſume.

The Mareſchal *de Vauban* did often aſſiſt with conſiderable Sums of Money ſeveral Officers that were not in a Condition to ſupport the Service; and when it was known, he ſaid his Deſign was only to reſtore the Overplus of the too great Favours that he had received from the King, and that were heaped upon him during the Courſe of a long Life; notwithſtanding which, he had the Glory to die with a moderate Eſtate. He was paſſionately addicted to the Service of the King, being a Subject of a moſt ſincere and zealous Fidelity, but nothing of a Courtier: He was much more deſirous of Serving than of Pleaſing: No body was more often, nor with more Courage than he, the Aſſertor and Champion of Truth, for which he had a Paſſion even to Indiscretion, and incapable of Government. His Morals always held
I good

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good against the most shining Dignities, and even without a Combat. In a word, he was a *Roman* whom our Age seemed to have Stolen from the most happy Ages of that great Commonwealth.

His Place of Honorary Academist was filled by the Mareschal *D'Esstrées*, Vice-Admiral of *France*, Grandee of *Spain*, Chevalier of the Orders of the King, and Governour of the *Nantois*.



The LIFE of the Abbot GALLOIS.

 *Obn Gallois* was born at *Paris* the 14th of June 1632. of *Ambrose Gallois*, Advocate in Parliament, and of *Frances de Launai*.

His Inclination for Learning appeared as early as he could shew an Inclination for any thing, and always increased with his Years; he applied himself to the Study of Divinity, and was admitted into the Order of the Priesthood.

Thus his Duty turned his Principal Studies to Ecclesiastical History, the Writings of the Fathers and the Holy Scriptures, and he extended them even to the Oriental Languages, necessary at least to those that would ascend to the first Springs of Divinity; but he did not renounce Prophane History, nor the Living Languages; such as the *Italian*, *Spanish*, *English* and *High Dutch*; nor the Mathematicks nor Natural Philosophy, nor even Physick it self: For his Zeal for Knowledge embraced

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braced every thing, and if it be true that a Learning so divided does less qualify a Man for a particular Reputation, it is at least much more proper to enlarge the Mind in all Senses, and to enlighten it on all Sides.

Besides the Knowledge of those Things that Books contain, Abbot *Gallois* had moreover acquired that of Books themselves, a Science almost distinct from the other, tho' it be the Consequence of them, and is produced by a lively Curiosity which neglects no Part of its Object.

The first Work which the Publick saw of this Gentleman, was a Latin Translation of the *Pyrenæan Treaty*, printed by Order of the King; but his Name soon became more Illustrious by his publishing the *Journal des Sçavans*. 'Twas in the Year 1665, that this Work first appeared, the Idea of which was so new and so happy, that it subsists even to this Day with more Vigour than ever, and has produced a numerous Issue scatter'd throughout all *Europe*, under the different Names of *Nouvelles de la Republique des Lettres*. *Histoire des Ouvrages des Sçavans*. *Bibliothèque Universelle*. *Bibliothèque Choisie*. *Acta Eruditorum*. *Transactions Philosophiques*. *Memoires pour l'Histoire des Sciences & des beaux Arts*, &c. *Monf. de Salle*, an Ecclesiastical Councillor in Parliament, first projected the Design of it, and joined the Abbot *Gallois* with him; who, by the great variety of his Learning seemed to be Born for this Employment, and who besides (which is not common with those that know every thing) understood *French* and writ it well.

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This Journal from its Birth assumed a great Authority to it self, and censured too freely most of the Writings that appeared. The Commonwealth of Learning which found its Liberty struck at, took up Arms, and damned the Journal at the end of three Months. But as the Project was Excellent in it self, the World would not suffer it to be quite lost, and *Monf. de Salle* giving it up entirely to the Abbot *Gallois*, he open'd the Year 1666, with a new Journal, which he dedicated to the King and put his Name to it; in which he ever after exercised the Jurisdiction he was possess'd of with all becoming Moderation.

Monf. Colbert, affected with the Usefulness and Beauty of this Journal, took a Fancy to the Work first; and soon after to its Author. In 1662, he gave him a Place in the New-born *Academy*, with the Office of Secretary in the Absence of *Monf. du Hamel*, who was two Years out of the Kingdom. The Abbot *Gallois* enriched his Journal with the principal Discoveries of the *Academy*, which at that time were scarce otherwise made known to the Publick than by that Means, and he moreover frequently gave an Account of it to *Monf. Colbert* by word of Mouth, presenting him with the Fruits of that Protection which he had granted to the Sciences. After which, that Minister being more and more pleased with his Conversation, always sent for him when he came to *Paris*; His Curiosity upon what Subject soever found him ready to satisfy him, and if a more exact and profound Discussion were necessary, no body could dispatch it in so short a Time as the Abbot *Gallois*, a Circumstance almost always necessary to *Monf.*

Colbert. Finally, this Minister who knew Men well, after having had a long trial both of the Wit, Learning and Manners of *Monf. Gallois*, took him to himself in 1673, and gave him always a Place both at the Table and in his Coach. So singular a Favour as this, was at the same time both a glorious Recompence of his Learning, and a continual Occasion to make an agreeable use of it, and a happy Necessity of improving it every Day.

Monf. Colbert favour'd Learning not only out of a natural Inclination, but of a wise Policy too. He knew that the Arts and Sciences were alone sufficient to make a Reign Glorious, that they extended the Language of a Nation perhaps beyond Conquests, that they bestow upon it the Empire of the Mind and of Industry equally pleasant and useful, that they attract a great number of Strangers, who enrich it by their Curiosity, fall into its Inclinations, and cleave to its Interests. During several Ages, the University of *Paris* did not less contribute to the Greatness of that Capital than the Residence of its Kings. To *Monf. Colbert* is owing the Splendour in which Learning finds it self at present, the Birth of the several Academies of *Sciences, Inscriptions, Painting, Sculpture and Architecture*, the new Favours which our Society has received from the King, the Impression of a great Number of excellent Books, at the King's Charge in the Royal Printing-House, the almost immense Increase of the Royal Library, or rather of the Publick Treasure of the Learned, an Infinity of Works which the great Authors, or able Mechanists do only grant to the Caresses of Princes and

and their Ministers, and lastly, a Taste of every thing that is great and fine, diffusing it self on all Hands, and continually increasing. The Abbot *Gallois* had the sensible Pleasure of viewing more nearly such a Minister, of being at the Fountain-head of those noble Designs which he formed, of sharing in their Execution, and sometimes even the Glory of suggesting them, and of seeing them followed. The Men of Learning had in him a Solicitor near the Prime Minister, and always instructed in their Affairs, tho' for the most part, they had not so much as the trouble of Recommending them to his Care. If any New Book, or any Discovery and Invention of an Author whom he did not so much as know, appeared in Publick with Reputation, he took care to inform Mr. *Colbert* of them, and the Recompence was seldom far off. The King's Bounty extended it self even to the Merits of Foreigners, and sought sometimes as far as the most Northern Countries for a Learned Man that was surpris'd to be found.

In 1672, the Abbot *Gallois* was received into the *French Academy*. Tho' Eloquence or Poetry are the principal Talents which that Society requires, yet she admits likewise of Erudition that is not Barbarous, and perhaps there is nothing else wanting to her, but to adorn her self a little more with the use she makes, and even with the occasion she has for it. In 1674, Mons. *Gallois* left off writing the Journal, and put it into other Hands. He was too much employed at Mons. *Colberts*, and besides that Work was too slavish for a Genius naturally so free as his; he could not
resist

resist the Charms of a new Book, which call'd him away, nor of a sudden Curiosity that seiz'd upon him, so that he was forced to sacrifice the Regularity required in writing a Journal to his new Passion.

The Commonwealth of Learning suffer'd a very great Loss by the Death of its Patron Monsieur *Colbert*, in the Year 1683. He had added to the Glory of having render'd it great Services, that of having done almost nothing for himself. Monsieur *Gallois* had only a moderate Pension from the Academy of Sciences, and an Abbey of so small an Income, that he did not think it worth the keeping. The late Marquis *Seignelai*, Son of *Monf. Colbert*, gave him the Place of Keeper of the King's Library, which was then in his Disposol; but it being out of his Hands afterwards, the said Marquis made him amends with the Office of *Greek* Professor in the Royal College, and with a particular Pension, which he obtained of the King for him, upon the Revenue of that College, and next to a kind of general Inspection. Monsieur *de Seignelai* did not think that his Father had done enough for him, and since the Frugality of *Monf. Colbert* is not to be charged upon his want of love for Learning, the little care he took of the Abbot *Gallois* must be placed to the account of that Gentleman's Moderation.

When under the Ministry of Monsieur *Pontchartrain*, at present Chancellor of *France*, the Academy of Sciences began, by the care of the Abbot *Bignon*, to recover it self out of the Languishment into which it had fallen; 'twas Monsieur *Gallois* that put in order the Memoirs of the *Academy*, which appear'd in 1692 and 1693; and whose care it was
to

to polish the Stile of them : But the great variety of his Studies did sometimes interrupt this Work, which was tied down to certain Times; so that he was oblig'd at last to quit it wholly. The *Academy* having taken a new Form in the Year 1699, he filled the Place of a Geometrician in it, and took for his Province the Geometry of the Ancients, and principally the Collection of *Pappus*; the *Greek* Text whereof having never been publish'd, he design'd to print, and to correct the *Latin* Translation which was very defective. Nothing was more agreeable to his Inclinations, and to his Talents also, than a Project which required the Love of Antiquity, a profound Skill in *Greek*, and Knowledge of the Mathematicks; and it was a Misfortune to Learning that this was no more than a Project. *One of the most pleasing Histories, and, without doubt, most Philosophical too, is that of the Progress of Humane Minds.*

The same Taſt for Antiquity which had tempted *Monſ. Gallois* to this Undertaking, a Taſt ſo hard to be contain'd within juſt Bounds, made him not very favourable to the *Geometry* of the *Infinities*, eſpouſed by all the Moderns. We cannot even diſſemble it, becauſe our *Histories* have declared it, that he openly attack'd this new *Geometry*. In general he was no Friend to Novelty, and beſides he oppoſed, out of a Spirit of *Oſtraciſm*, every thing that made too great a Figure in a Free State, ſuch as that of Learning: The *Geometry* of the *Infinite* had thoſe two Faults, eſpecially the latter; for to ſpeak the truth, it cannot be eſteem'd entirely novel; and the zealous Partifans of Antiquity would much better find their Account in maintaining that
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the ancient Geometricians knew and practised the first Foundations of it, rather than to oppose it upon the Supposition that it was unknown to them. *

As all the Objections made against the *Infinitely Littles* had been follow'd by a demonstrative Solution, the Abbot *Gallois* began to offer some, under the Pretext of clearing his Doubts ; and perhaps the different Resources which his Genius might have furnish'd him withal, would not have been so soon exhausted, if from a perfect and vigorous Health he then enjoy'd, he had not fall'n at once into a Distemper, whereof he died the 19th of *April*, 1707.

He was of a lively, stirring and jovial Temper, a bold Genius, very fertile in Expedients whenever he wanted them, and capable of carrying him a great way out of a sense of Honour. He had no other Employment than Books, nor no other expensive Pleasures than that of buying them. He had gather'd together above 12000 Volumes, and was daily adding to them. If so numerous a Library can be useful, it was to a Man of his vast Learning, whose Curiosity hurried him to a thousand different Objects, and it must be contented upon the spot. His Morals, and especially his Disinterestedness, shined throughout his whole Life whilst he was with Monsieur *Colbert*. Christian Charity gave that Natural Disinterestedness its utmost Perfection ; he only reserved to himself, out of the Abbey of *St. Martin de Cores*, a Pension of 600 Livres, and left 'em to his Successor, to be distributed among the Poor of the Country. His place of *Pensioner Geometrician* was filled by Monsieur *Saurin*.

The LIFE of Monsieur DODART.

N*icolas* *Dodart*, Physician to the King, to the Princess Dowager of *Conti*, and to the present Prince, Regent Doctor in the Faculty of Physick at *Paris*, was born in 1634, of *John Dodart* Citizen of *Paris*, and of *Mary Dubois*, Daughter of a Lawyer. *John Dodart*, tho' he was unlearned, had a great deal of Sense, and that which is most valuable, of good Sense. He had even made a good Collection of Books, and enough for a Man who was not expected to know any thing. *Mary Dubois* was a Woman that distinguished herself by a very agreeable Temper, and by a Heart much above her Fortune. The reason why we make this little Picture of the Father and Mother, is because of the relation it may bear to that of the Son. It is but just that we should place to their Account, and do honour to their Memory, for the share which they had in his natural Merit.

They were not contented to Instruct their Son in Latin and Greek, but they joyned to it Painting, Musick, and such like Exercises which are only the Ingredients of the most chargeable Education, and which are but too much consider'd as agreeable Superfluities. He succeeded in them all, so as to give the greatest hopes of himself, and finished his Studies so early that he had leisure enough to apply himself equally to Law and Physick, that he might the better determine himself which Profession

feſſion he would ſtick to. He is perhaps the only Man that would chuſe with ſo much *Cogniſance of Cauſe* ; 'Tis true indeed that he did at the ſame time ſatiſſie his own great Thirſt after Knowledge.

He declared at laſt for Phyſick, his natural Inclination byaſſing him that way ; but that which determined him yet more powerfully was, that he ſaw in it no Danger in reſpect to *Juſtice*, but infinite Occaſions for exerting *Charity* ; for he was even then affected with the ſame Sentiments of Religion, that remained in him all the reſt of his Life.

It is eaſie to imagine with what Ardour and Perſeverance a Man of Underſtanding applies himſelf to a Study, when it becomes his eſſential Duty. He diſtinguiſhed himſelf very much as he went thro' his Courſes of Phyſick, and we have authentick Proofs thereof, as well as of his Character in his earlieſt Youth. *Guy Patin* in his 186th Letter of the Edition of 1692, ſpeaks thus of him :
 “ This day the 5th of *July*, 1660, we have Li-
 “ cenced our Old Batchelors ; there is Seven of
 “ 'em in Number, of whom the ſecond, named
 “ *Dodart*, aged 25 Years, is one of the wiſeſt
 “ and moſt knowing Men of this Age. This
 “ Young Man is a Prodigy of Wiſdom and of
 “ Learning, *Monſtrum ſine Vitio*, as *Adrian Tur-*
 “ *nebus* ſaid of *Joſeph Scaliger*”. Afterwards, in his
 190th Letter, he ſpeaks further of him thus :
 “ Our learned Licentiate is named *Dodart*, Son
 “ of a very honeſt Man and Citizen of *Paris*.
 “ 'Tis a great Lad, very Wiſe and very Modest ;
 “ he knows *Hippocrates*, *Galen*, *Ariſtotle*, *Cicero*,
 “ *Seneca*, and *Turnel*, by heart. He is an admi-
 “ rable

“rable Fellow, and is not yet 26 Years old ; for
“the Faculty at the first Examination of him
“gave him his Grace for some Months, which
“were wanting to qualifie him for his Degree,
“out of the good Opinion that they had con-
“ceived of him before-hand”. All these Circum-
stances of the Account Mr. *Patin* gives of him,
are worthy our Attention. He was a Physician
himself, and a very Learned one, passionate for the
Glory of Physick ; and the Letter, in which he
mentions *Monf. Dodart*, was writ to one of his
Friends with a Freedom even to excess ; Pane-
gyrick is not very common in his Letters, in
which the Gall of an independant Philosopher did
mostly predominate ; there was neither Kindred
nor Friendship between him and *Monf. Dodart*,
nor was he at all concerned for him ; he took no
notice of any other young Students ; in a word,
he was no Bigot, so that an air of Religion must
be very sincere, to make it self amiable in his Eyes.
If Self-love were a little more nice, nothing would
be accounted Praise without the like Qualifications.
Monf. Patin, in his 207th, 208th, and 209th Let-
ters, continues to give his Friend an account of
Monf. Dodart. Sometimes he calls him, *our Li-*
centiate so Wise and so Knowing, and sometimes
our Learned young Doctor : He always keeps him
in sight, only by a simple Curiosity, which was
so much the greater Compliment as it was alto-
gether Indifferent.

Men of the most opposite Sentiments joyned in
the Commendation of *Monf. Dodart*. *Father Des-*
champs, of a Society that was not much esteemed
by *Monf. Patin*, having heard by chance the young
Doctor

Doctor reading a Lecture in the Physick Schools, was so touch'd with the Purity of his *Latin*, that upon the account he gave of it to *Monf. de Brienne*, at that time Secretary of State for Foreign Affairs, that Minister began to cast his Eyes upon him, and having inform'd himself farther about him, he had a great desire to engage him in his Service as First Clerk under him. The Beginnings of those Men who have nothing but their own Merit to introduce them into the World, are generally obscure and slow enough ; and the Establishment of *Monf. Dodart* was at that time very moderate, and yet nether a considerable Fortune that threw it self in his way, nor the tempting splendour of a Place at Court, could make him renounce his first Choice. His Constancy was supported by more noble Principles, which perswaded him that Heaven had destined him for the Place he was in. *Monf. Brienne*, to engage him insensibly, desired only of him that he would write some of his most important Letters, and he obliged him in it, but cautiously avoided that Snare, which another Man would have cheerfully run into.

His Attachment to his Profession had its Reward. He became quickly known, and the Dutcheß of *Longueville* took him for her Physician. She was at that Time famous for that great Piety which only ended with her Life ; she had a great Esteem for Men of Sense, and not only for that kind of Sense which distinguishes a Man in one certain Way, but chiefly for that which a Man may carry every where a long with him. She was too much accustomed to it, to be able to live without it, and any other Language would have been too great

a Stranger to her. A good Physician, but without this sort of Sense, or a great Fund of Piety, would not have been agreeable to her. She therefore soon honoured *Monf. Dodart* by the Trust she put in him; I mean, such as one conceives for a true Friend, of which the great inequality of their Conditions gave him all but the Name.

The late Dowager Princess of *Conti*, Mother to the two Princes of *Conti* and *de la Roche-Sur-Ton*, was desirous of sharing *Monf. Dodart* with *Madam de Longueville*; and as she bestowed upon him the same Title, she gave him that which in respect to him was inseparable from it, the same Confidence, and the same Familiarity: But which is yet, if it were well consider'd, more Glorious for him, than even the Friendship of these two Great and Virtuous Princesses, he was beloved by all those that were about them. One need not be acquainted with many Families of great Men, to know, that to be well with all the World, is a Master-piece of Conduct and Wisdom, and oftentimes the more difficult, by how much one has other great and bright Qualities. The true Secret for succeeding therein, was that which he always practis'd; he oblig'd every one as much as was possible, and spared not his Interest in serving others. To want his Credit, and to have a Right to use it, was with him one and the same thing, which was happy for a great Number of deserving Men: The two Places he was possess'd of, made him known to a great many other Persons of the first Quality, or in the highest Stations. And I am not afraid to say, that notwithstanding they were so much above him, they conceived for him that kind of Respect, which was not

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establish'd by Men, and whereof Nature has reserved to her self the Right of disposing, in favour of Virtue.

After the Death of the old Princess of *Conti*, he attached himself to the two Princesses her Children; and after the Death of the Eldest, to the Princess of *Conti* his Widow, and to the Young Prince their Son; nothing can exceed the Zeal, Fidelity and Disinterestedness which he carried with him into their Services; but one cannot determine whether such Patrons did not render those fine Qualities more perfect than naturally they would have been. He had the good luck to succeed in the dangerous Distempers with which the Princess was visited, and that also of pleasing the Prince of *Conti* by the solid Charms of his Conversation. Every one knows how great a Man that Prince is, and how good a Judge of others.

In 1673, *Monf. Dodart* came into the *Academy of Sciences*, by the means of *Monf. Perraut*. Those Gentlemen had great Credit with *Monf. Colbert*, and made an extraordinary Use of it, which was to make known to that Minister, and to procure his Favour for those that had great Talents, as well as they themselves.

The Academy had already undertaken the History of *France*, a Work of a vast extent, and *Monf. Dodart* took the labouring Oar upon himself. At the end of three Years, that is to say in 1676, he placed at the Head of a Volume (which the Academy printed under the Title of *Memoirs to serve for the History of France*) a Preface, in which he gave an account, both of the Design it self, and of what had been done therein to that Time. We have

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have not any other Work of his in Print, and by good luck, the Matter of it has given him an opportunity perfectly to paint in it his own Character. A long Enquiry, and a nice Discussion, were absolutely necessary in such a Work; and he possessed in a sovereign Degree the Spirit both of *Discussion* and *Enquiry*. He knew on which side, or rather upon how many different sides he was to extend his View, and as one may say, to direct a Telescope. Every one knows not how to see, and we often take for an entire Object the first Face which Chance presents us with; but *Monf. Dodart* had the Patience to seek for all the rest, and the Art to discover them, or at least the Precaution of suspecting those which he could not discover. 'Tis not only the greatest Objects which have several Faces, the very smallest have them also; and a strict Attention is a kind of a Microscope, which serves to magnifie them. 'Tis true indeed, that this kind of scrupulous Attention, which never believes it has view'd a thing sufficiently, this care of turning an Object every way, in a Word, this Spirit of *Discussion* is very contrary to that of *Decision*; but it is more the Business of the *Academy* to Examine than to Decide, diligently to trace Nature by exact Observations, and not to prevent her by rash Judgments.

Nothing better becomes our Reason, than that her Conclusions should be a little timorous, and even when she has a right to Decide, she would do well to abate something of it: One may take the Preface that we have now quoted for a Pattern of a Theory embraced in its utmost extent, traced even to its least

Dependencies, very nicely discussed and seasoned with a most amiable Modesty.

This same Spirit ran thro' the whole Exercise of Monsieur *Dodart's* Profession, and was moreover strengthened with an extream Delicacy of Conscience. A Patient had no occasion either to fear his Neglect, or even a light and superficial Application, but only (for we must tell all the Truth) his too great Care and Application, which render'd him sometimes Irresolute in the Choice of his Remedies. The Practice in Physick does not always admit of the wise Delays of Speculation, and sometimes even Reason it self requires that we should act with Precipitation.

The *History of France* was the chief Work of *Monf. Dodart* in the *Academy*, but not the only one; he applied himself very diligently to study the insensible Transpiration of the humane Body. All the Naturalists, and the Physicians too, had always a Notion of it, but so general and uncertain, that all they knew of it, properly speaking, was only, that there was such a thing as Transpiration.

The illustrious *Sanctorius*, a Physician of *Padua*, was the first that knew how to reduce it to Calculation by Experiments, and to compare the Quantity of it with that of the grosser Evacuations. It far exceeds what one could ever have imagined; there may come out of the Body in one Day, according to the said *Sanctorius*, seven or eight Pounds of Matter by Transpiration, and as such an abundant Evacuation must needs be of great Importance, several eminent Physicians consider it as one of the principal Foundations both of their Theory and Practice. But since *Sanctorius* was the first who

had conceived these fine Notions, he could not be supposed to have carried them to their utmost Perfection. For instance, tho' he knew in general that Transpiration ought to be different, according to Mens Ages, he does not seem to have minded that Difference neither in his Observations, nor in the Conclusions he drew from them; but Monsieur *Dodart* satisfied himself by many Experiments continued for the space of 33 Years, that Transpiration is much greatest in young People: Indeed it is much more natural that the Heat of the Blood becoming more weak in proportion as we grow older, should protrude fewer of the subtile Particles, and that at the same time the Pores of the Skin should be more closed. *Monf. Dodart* was peculiarly adapted to make these kind of Experiments, because they are best made upon one's self, and because he that makes them must lead an even and uniform Life, and alike not only every Day, but in the different Stages of Life; otherwise one could not compare, without great Mistakes, or at least Uncertainties, the Transpirations of different Times. An irregular Alternative of Intemperance and Sobriety would spoil all.

He made another Experiment upon the same Occasion, for which the Uniformity of Life would not have sufficed alone; it may perhaps appear surprising to affirm, that a great Piety was likewise necessary thereto. Upon the first Day of *Lent*, 1677, he found that he weigh'd one hundred and sixteen Pounds, one Ounce: He then proceeded to live all the rest of the *Lent* as was the practice of the Church 'till the 12th Century, that is, he did neither eat nor drink 'till six or seven a Clock in the

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Evening : He lived upon Garden-stuff the most part of the time, and about the end of it upon Bread and Water. On *Easter-Eve* he weigh'd no more than a hundred and seven Pounds, twelve Ounces, that is to say, he had lost, by this austere way of living, in 46 Days, eight Pounds, five Ounces, which was the fourteenth part of his Substance : He then resumed his ordinary Course of Life ; and at the end of four Days he had recover'd four Pounds ; which shews that in eight or nine Days he would have arrived at his first Weight, and that one easily repairs all that is lost by Fasting. When he gave an account of this Experiment to the *Academy*, he took all possible Precaution to conceal himself, but he was discover'd. It is extraordinary enough, not that a Philosopher should be a good Christian, but that the same Action should be a curious Observation in Philosophy and a Christian Austerity, and serve at the same time both for *Heaven* and the *Academy*.

He made the like Remarks upon Bleeding, that 16 Ounces of Blood, for instance, would be recover'd in less than five Days in a Person that was robust and healthy : It remains to know, in how long time a sick Man might recover his ; and it is plain that such Principles would decide the great Question of the Utility or Danger of letting Blood, and would regulate the Proceedings in that matter. But tho' *Monf. Dodart* himself had made many of these Experiments in a long Tract of Time, yet he fell far short of perfecting those Enquiries. It appears by what I have been able to collect on the same account, that commonly the Strength of Transpiration is in the first Hours that follow a good Meal ;

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Meal; tho' *Sanctorius* places it about the middle of the Interval between two Meals. This whole Business does still abound with Uncertainties; and if one did maturely reflect upon the Difficulty of collecting as many Tracts as are wanting with respect to different Ages, Temperaments, Climates and Seasons, it is so great, that Naturalists must almost despair of reducing it to any certain Rules.

Monsieur *Dodart* had some thoughts of composing a History of Physick. Mr. *Le Clerc*, a Physician at *Geneva*, and Brother of the famous *Le Clerc* of *Holland*, has worthily perform'd this great Design, and in his Preface acknowledges that he had interfered in that Undertaking with the Learned *Monf. Dodart*, among whose Papers were found several Memoirs relating to that matter; such as about the Diet of the *Ancients*, about their Drink, *Ptisan*, &c. The Remarks about Transpiration were likewise to make part of his intended History.

He had also projected a *History* of *Ancient* and *Modern Musick*; and that which has been publish'd in the *Memoirs* of the *Academy* upon the *Formation* of the *Voice*, was to have been a Preliminary, or Introduction, to it. It is perhaps an Affliction to the Publick, to inform them of these different Projects, which have remain'd abortive in such learned Hands; but there is no Great Man who has not given them the same Cause of Dissatisfaction: A Genius and Stock of Knowledge suggests more Designs, and inspires Men with a more enterprising Courage, than agrees with the Rigour of humane Condition, and, perhaps, we should not do all that we are able, if we did not flatter our selves with the Hopes of going much farther. All these Projects

jects, begun without encroaching upon the ordinary Duties of his Function, do sufficiently shew how laborious a Man *Monf. Dodart* was. His Pleasures and Amusements were only less painful Labours, such as plain Lectures, but which were always Solid and Instructive. He read much upon the Matters of Religion, for his Piety was enlighten'd, and to the Light of Reason, he always joined the reverend Obscurity of Faith.

He was Physician to a great Number of Poor People, and perhaps to a greater Number than he could well be, according to his Way; for he did not only Cure them, but Feed them too; for which reason he was obliged to join in these charitable Works with several People of Figure, and to go about begging Alms himself, that he might be the better enabled to bestow them on the Poor.

At the Age of about 73 Years, after having endured long Torments in the Kidneys without making them known, he was of Opinion that he had the Stone, and resolved to undergo the Operation of it chearfully. The Princess of *Conti* did all that was possible towards composing a most troubled and uneasie Mind, and did it with so much the more Generosity, as the Dispositions of the Patient obliged her less to it. She assured him that *Monf. Dodart* his Son should succeed him as her Physician, and that she would give his Daughter a Pension, by way of Suppliment to the small Fortune he was like to leave them.

It was found afterwards that he had not the Stone. He was doomed to lose his Life in the happiest manner in the World, by an Action of Charity. One day he over-fatigued himself in
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taking care of some poor People, caught a great Cold, and returned to his own House fasting about five a-Clock in the Evening. A Fever, which quickly appeared, and a Defluxion upon the Breast, carried him off in ten Days time: He died the fifth of *November*, 1707, a Week before the Anniversary Meeting of the *Academy* upon *St. Martin's-day*; a Circumstance very favourable to the Honour of his Memory; for as I was not able to make his Funeral Oration in so short a Time, the Abbot *Eignon* did it without any Warning hardly, just as his Heart suggested it to him; and *Monf. Dodart* is the only Man hitherto that has had that Happiness.

Whilst his Distemper lasted, the Princess of *Conti* sent every Hour to enquire after his Health, and as soon as he was dead she performed all she had promised. One might suppose that all this did only proceed from the general Beneficence of that Princess, or from an indifferent Generosity; but Tears can only come from the bottom of the Heart, when Decency don't require them; and when, on the contrary, the extream Inequality of the Persons rather seems to oppose them; to the natural Eloquence which they have in making an Elogium may be joyned the Value and Price that is set upon them by the Eyes that shed them.

Monsieur Dodart was always of a serious Temper, and that Christian Attention with which he perpetually watched over himself, was not like to diminish it; but that Seriousness, far from carrying with it any thing of Sourness or Melancholy, discover'd at the bottom a wise and lasting Joy, which is the Fruit of a refined Reason, and
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of a peaceful Conscience. This Disposition does not produce extravagant Mirth, but an even Sweetness, which however may become Gaiety for a few Moments, and as it were, by way of surprise; and from all that together there results an air of Dignity which belongs to Virtue only, and which even Greatness it self cannot bestow. One thing more, which tho' infinitely less considerable, is very becoming, and *Monf. Dodart* had it in Perfection, it is a Nobleness of Expression; for besides that it is I know not what part of our Manners, it proves that we have lived in choice and select Company, for in such only it is acquired, and in such only it is brought to Maturity. He had moreover a great natural facility in Speaking, to which he joined that uncommon Merit of never abusing it; and he had formed to himself a Stile, which, without being affected, did only belong to him. He was possess'd in a high degree of the peculiar Qualities of an Academist, that is to say, of a Man of Sense, who knows how to live with his Equals, benefit himself by their Lights, and communicate his own to them. In this kind, People had much rather *Give* than *Receive*; tho' giving as one ought, is much more difficult than receiving. *If it be hard to act the Person of an Inferiour when one Receives, it is much more hard not to assume an Air of Superiority when one Gives:* *Monf. Dodart* understood perfectly both the one and the other; he proposed his Thoughts with such a Modesty, as made them become almost a new Proof; and he enter'd so readily into the Sentiments of others, as if he had not known 'till that Moment what he was informed of by

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by them. He loved to borrow, and to put a Value upon their Notions, and he would much rather have succeeded than failed in taking an Opportunity of rendering a kind of Homage for them. It would not be necessary to give you a larger Description of his Manners, all of them proceeding from one sole Principle, a Heart naturally Sincere and Noble, and continually cultivated by Religion.

His Place of *Pensioner Botanist* was presently filled by *Monf. Burlet*, who had been his *Pupil*; but because *Monf. Burlet* was first Physician to the King of *Spain*, he was declared *Veteran*, and the Place of *Pensioner* given to *Monf. Morin*, Physician to the *Hotel-Dieu*, who was *Associate Botanist*.



The LIFE of Monsieur TOURNEFORT.

The *Josepb Pitton de Tournefort* was born at *Aix* in *Provence* the 5th of *June*, 1656, of *Peter Pitton, Esq;* Lord of *Tournefort*, and his Mother was *Aimare de Fagone*, a Noble Family in *Paris*: He was sent to the *Jesuits College* in *Aix*; but tho' he was only put to the Study of *Latin*, like all the rest of the Scholars, as soon as ever he saw the Plants in their Garden, he found himself growing into a *Botanist*; he earnestly enquired after their Names, carefully observed their Differences, and sometimes played Truant to go a *Simpling* in the Fields, and studied Nature instead of the Language of the Ancient

cient *Romans*. The greatest part of those who have excelled in any kind of Knowledge never had any Master: In a little time he learnt of himself to understand all the Plants round about the City.

When he was come to his Philosophy, he had very little relish for that which they taught him; he did not find in it that Nature which he so much delighted to observe, but only indefinite and abstract Idea's, which, as one may say, go besides the things, without touching upon them. He met with the Philosophy of *Descartes*, little known then in his Country, in his Father's Closet; and presently found it to be what he had been looking for. He could not enjoy the reading of it but privately, and by Snatches, but that made him the more eager after it, so that his Father, who opposed so profitable a Study, gave him, without designing it, an excellent Education.

As he had devoted him to the Church, he obliged him to study Divinity, and put him into a Seminary; but Nature prevailed, and he was resolved to see Plants, and so made his most favourite Studies either in a curious Garden belonging to an Apothecary of *Aix*, or in the neighbouring Fields, or upon the Precipices of Rocks and Mountains: He made his way, either by Art or Presents, into the most private Places, where he guessed there were Plants that he could meet with no where else; and rather than fail, he would climb over the Walls, insomuch that he had like to be knock'd in the Head one time by some Country Fellows that mistook him for a Thief.

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He had not a less violent Passion for Anatomy and Chymistry, than for Botany. In fine, Natural Philosophy and Physicks challenged him with such Warmth from Divinity, which had unjustly taken Possession of him, that this latter Science was forced to give him up; he was encouraged by the Example of his Uncle by the Fathers side, an able esteemed Physician, and the Death of his Father, which happened in 1677, left him entirely Master of his own Inclinations.

He presently made use of his Liberty, and in 1678, visited all the Mountains of *Dauphiny* and *Savoy*, from whence he brought a great many Plants dried, which were the beginning of his Herbal. Botany is not such a sedentary and lazy Science, as can be acquired in the Ease and Shade of a Closet, like Geometry and History, or, at most, like Chymistry, Anatomy and Astronomy, which do not require any Operations that are attended with much Bustling. But this, on the contrary, obliges you to run about Mountains and Forests, and to grapple with craggy Rocks, and to expose your self on the brinks of Precipices: The only Books that can fully instruct us in this Matter, are spread by chance over the Surface of the Earth, and you must resolve to undergo the Fatigue and Danger of seeking and gathering them up. From hence it comes to pass, that it is so uncommon a thing to excel in this Science, and that degree of Zeal, which is necessary to make a learned Man of another kind, is not sufficient to make a great Botanist; and that Zeal likewise ought to be accompanied with such a degree of Health, and such a strength of Body, as are equal to it. *Monf. de Tournefort*

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nefort was of a brisk, laborious and robust Constitution; the great Stock of natural Liveliness supported him in his Business, and his Body as well as Mind were both made for Botany.

In 1679, he set out from *Aix* to *Montpellier*, where he improved himself very much in Anatomy and Physick. A Garden of Plants, which was the Gift of King *Hen. IV.* to this City, as rich as it was, could not satisfy his Curiosity. He made his Excursions above ten Leagues round *Montpellier*, and brought back Plants unknown even to the People of the same Country; notwithstanding which, he was resolved to extend his Enquiries much farther, and so in the Month of *April*, 1681, left *Montpellier* for *Barcelona*, and went even as far as *St. John's* in the Mountains of *Catalonia*; whither he was followed by the Physicians of the Country, and the young Students, to whom he described the Plants. One might have compared him upon this Occasion to the old *Gymnosophists*, that used to carry their Disciples into the Deserts where they kept their School.

The lofty *Pyrenæan* Mountains were too near not to tempt him, tho' he knew that he should meet with no other Subsistence in those vast Solitudes, but such as served the most rigid Hermits; and that the miserable Inhabitants that were to provide it for him, did scarce exceed in Number the Robbers whom he had to fear; and indeed he was several times actually plunder'd by the *Spanish Miquelets*.

This made him find out a Stratagem by which he cheated those Thieves, and saved a little of his Money; he put it into some Loaves of Bread, which he

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he carried with him, and which were so black and so hard, that tho' they searched him very carefully, and were not so nice as to despise any thing, yet they scorned to touch his Bread.

His predominant Inclination made him surmount all Difficulties; those dreadful, and almost unaccessable Rocks that encompassed him on all sides, appeared to him no other than a stately Library, in which he had the Pleasure of finding all that his Curiosity required, and in which he spent his Time most luxuriously. One day a miserable Cottage in which he lay fell down all at once, and he was two Hours buried under the Ruins of it, and had infalliably perished, if People had not come in the mean time to his Relief.

He returned to *Montpellier* at the end of the same Year 1681, and from thence to his own Country of *Aix*, where he rank'd in his Herbal under their proper Classes, all the Plants he had collected in *Provence*, *Languedoc*, *Dauphiny*, *Catalonia*, the *Alps* and the *Pyrenæan Mountains*. It is not for all the World to understand that the Pleasure of seeing a vast number of such Plants very compleat, well preserved, disposed in good Order, in great Books of white Paper, could sufficiently recompence all the Pains he had taken, and Charges he had been at, in bringing them together.

'Twas the good Fortune of Plants, that *Mons. Fagon*, at that time first Physician of the late Queen, had applied himself very much to the Knowledge of them, as one of the most curious Parts of Natural Philosophy, and one of the most Essentials to Physick, which made him favour the Science of Botany, with all the Power that that his Place and Merit

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Merit gave him. The Name of Monsieur *Tournefort* came to him from so many places, and always with so much Uniformity, that he had a great mind to draw him to *Paris*, the general Rendezvous of almost all the great Talents dispersed in the several Provinces: He applied himself for that purpose to Madam *de Venelle*, Sub-Governess of the Children of *France*, who was well acquainted with all the Family of the *Tourneforts*. She prevailed upon him to come to *Paris*, and in 1683, brought him to Mons. *Fagon*, who at the same time procured him the Employment of Botanick Professor to the Royal Garden of Plants, founded at *Paris* by *Lewis XIII.* for the Instruction of Young Students in Physick.

This Office did not hinder him from making several Voyages.

He returned into *Spain*, and from thence to *Portugal*, where he saw Plants that were scarce known to any Botanist.

In *Andalusia*, which is a Country abounding in *Palm-Trees*, he had a mind to learn the Truth of what has been so long related concerning the Loves of the *Male* and *Female* of that Kind, but he could discover nothing certain; and those ancient Amours, in case there be any such, do still remain a Mystery. He went likewise into *Holland* and *England*, where he found both Plants and several great Botanists, whose Esteem and Friendship he quickly gained, of which there can be no greater Proof given than the Desire that Mons. *Herman*, a famous Professor in Botany at *Leyden*, had of resigning his Place to him, being very old himself. He writ to him about it at the beginning of the
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last War very earnestly, and the Zeal he had for the Science he professed, made him chuse a Successor, who was not only a Foreigner, but of a Nation that was at that Time an Enemy to his. He offer'd Monsieur *Tournefort*, in the Name of the States-General, a Pension of 4000 Livres a Year, and gave him hopes of an Augmentation when he should be better known. The Salary belonging to his Office in the Royal-Garden was very moderate; however the Love of his Country made him reject those agreeable and advantageous Encouragements. He had likewise another Reason which he communicated to his Friends, *viz.* That he found the Sciences were at least arrived at as high a pitch of Perfection in *France*, as in any other Country. And a learned Man looks upon none to be his true Country, but where the Sciences are in a flourishing Condition. *France* was not ungrateful to him for that Preference. The *Academy of Sciences* having been put under the Direction of the Abbot *Bignon*, in the Year 1691, one of the first Uses that Gentleman made of his Authority two Months after he had been invested with it, was to chuse into the Body *Monf. Tournefort* and *Homborg*; neither of whom were otherwise known to him, than by the Reputation they had acquired. After they had been approved by the King upon his Recommendation, he presented them both at once to the *Academy*, two first Born, as one may say, and both worthy to be so of such a Father, and an Earnest of the whole ingenious Family that has followed them.

In 1694, appeared the first Work of Monsieur *Tournefort*, entitled, *The Elements of Botany*, or,

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The Method of knowing Plants; Printed at the *Louvre*, in 3 Vols. Octavo. It brings into Order that prodigious number of Plants so confusedly dispersed upon the Earth, and even under the Waters of the Sea, distributes them into their Kinds and Species, facilitates the Knowledge of them, and hinders the Memory of a Botanist from being over-loaded with an Infinity of different Names.

This Order, tho' so very necessary, is not contrived by Nature, which prefers a magnificent Confusion before the Ease and Convenience of the Naturalists, and it is their Business to range them, and bring them under a System, almost in spite of Nature. Since therefore it can only be a Work of their Genius, it is easie to foresee that they will be divided upon it, and even that some of 'em will be for no System at all: That which *Monf. Tournefort* thinks the best, after a long and learned Discussion, consists in regulating the Kinds of Plants by the *Flowers* and *Fruits* taken together; that is to say, that all the Plants that agree in those two Parts, shall be accounted of the same Kind, after which the Differences either of the *Root*, of the *Body*, or *Leaves*, shall constitute their different Species. *Monsieur Tournefort* has even gone farther: Above the *Kinds* he has placed *Classes*, which are only regulated by the *Flowers*, and he is the first that had this Thought, which is much more useful in Botany than one would be apt to think at first. For 'till now there does not appear above 14 different *Figures* of *Flowers* necessary to be imprest upon the Memory; so that if you take into your hands a Plant in Flower, of which you know not the Name, you presently find in his *Elements of Botany*,

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Botany, to what Class it belongs; some Days after the Flower appears the Fruit, which determines the *Genius* in the same Book, and the other Parts shew the *Species*, so that you find in a Moment both the Name given by *Monf. Tournefort* with respect to his System, and the Names given by the rest of the most famous Botanists, either out of their own particular Systems, or without any System at all: By this means one is able to study a Plant in the Authors that make mention of it, without danger of applying to it what they have said of another, or of attributing to another what they may have writ concerning this. 'Tis a wonderful Ease to the Memory that all is reduced to the retaining 14 Figures of Flowers, by the means whereof one descends to 673 *Kinds*, under which are comprehended 8846 *Species* of Plants, whether belonging to the Earth or the Sea, all known at the Time of publishing this Book. What would it be, if one were obliged to learn immediately these 8846 *Species*, and that under all the different Names that Botanists have been pleased to bestow upon them? What we now say might perhaps require some Restrictions or Explanations: But they have been already given in the History of the Year 1700, where the System of *Monsieur Tournefort* has been more fully treated of.

This Book appeared to be very well approved by the Naturalists, and that ought never to be understood otherwise than of the greatest number of Naturalists. It was attacked upon several Heads by Mr. Ray, a famous *English* Botanist, and Natural Philosopher, whom *Monsieur Tournefort* answered in 1697, by a Latin Dissertation, in-

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scribed to Dr. *Sherrard* another Englishman, and Learned in the same Science. The Dispute was without Bitterness, and even handled civilly enough on both Sides, which is remarkable. It may be said perhaps that the Subject was not worth the while, for what was it about? To know whether the Flowers and the Fruits suffice to establish the Genus? and whether one particular Plant was of this or that Kind? But it is a Favour if Men, and particularly the Learned, don't fall into a Passion while they are disputing upon the smallest Matters. Monsieur *Tournefort*, in a Work subsequent to these Debates, has bestowed great Encomiums upon Mr. *Ray*, and even upon his System of Plants too.

He was admitted to his Doctor's Degree by the Faculty of the Physicians at *Paris*, and in 1698, published a Book entitled, *A History of the Plants that grow about Paris, together with their Use in Physick*. It may easily be imagined that he who had been looking for Plants upon the Tops of the *Alps* and the *Pyrenées*, would not suffer the Country about *Paris* to escape his nicest Enquiries, since it was the Place of his Residence. Botany would be but a simple Curiosity if it were not for its Relation to Physick, and one makes the best use of it when one applies ones self chiefly to study the Botany of ones own Country; not but that Nature may have been likewise as careful, as she is sometimes said to be, in bestowing upon every Country the Simples that are best adapted to the Distempers of the respective Inhabitants; but however it is most convenient to make use of those that are at hand, and very often such as are
fetch'd

fetch'd from far, are not the better for that. In this History of the *Parisian Plants* *Monf. Tournefort* gives an account, besides their different Names and Descriptions, of the Chymical Analysis made of them by the Academy, and of their most ascertained Qualities. This Book alone might sufficiently obviate the Reproach that is sometimes made by Physicians of undervaluing the Remedies drawn from Simples, because they are too easie and of too quick an Effect. Certainly *Monf. Tournefort* produces a great Number of them, and yet they are for the most part but too much neglected, and we seem to be under a kind of a Fatality in desiring them much, and using them but little.

One may count among the Works of *Monsieur Tournefort*, a Book, or at least a part of a Book, which however he did not publish: the Title of it is, *Schola Botanica, sive Catalogus Plantarum, quas ab aliquot annis in Horto Regio Parisiensi studiosis indigitavit Vir Clarissimus J. P. de Tournefort, D. M. ut & P. Hermani Paradisi Batavi Prodigromus, &c. Amstel. 1699.* An Englishman, named *Mr. Simon Wharton*, who had studied Botany three Years at the King's Garden under *Monf. Tournefort*, composed this Catalogue of the Plants which he had seen there.

As the *Elements of Botany* met with all the Success the Author himself could wish for, he Translated it into *Latin*, and published it in 1700, for the Benefit of Foreigners, with Additions, under the Title of *Institutiones Rei Herbariæ*, in three Volumes in *Quarto*; the First of which contains the Names of the Plants distributed according to the Author's System; and the other

two, their Figures very well engraven. At the Head of the Translation there is a large Preface or Introduction to Botany, which contains, besides the Principles of *Mons. Tournefort's* System ingeniously and solidly laid down, a *History of Botany and of Botanists*, collected with great Care, and writ in a very agreeable Stile. One may easily believe, that he employed himself with Pleasure in every thing that had a relation to the Object of his Love.

This Love however was not so faithful and constant to Plants, but that it extended it self with the same Zeal almost to all the other Curiosities of Nature; such as figured Stones, uncommon *Marcaffites*, extraordinary *Petrifications* and *Chrystalizations*, and *Shells* of all Kinds. It is true, that out of the Number of these sorts of Inconstancies, his Love for Stones may be excepted, because he ranked them among the Number of Vegetables, and supposed them to come from Seeds; nay, he was sufficiently inclined to extend this System even as far as Metals, and it seems, if it were possible, that he transformed himself into that which he most loved.

He made a Collection likewise of the *Dresses*, *Arms* and *Instruments* of remote Nations, other kinds of Curiosities, which tho' they do not immediately come out of the hands of Nature, are not the less Philosophical, especially when they fall into those of a Philosopher; of all these things together, he had formed a splendid Cabinet for a private Person, and famous in *Paris*. It was esteemed by the Curious to be worth near 50000 *Livres*. Such a great Expence would have been a
Blot

Blot in the Life of a Philosopher, if it had been made upon any other occasion; it proves that *Monf. Tournefort* with so narrow a Fortune as his was, could allow little or nothing to more trivial, and yet more practised Pleasures.

With all these good Qualities, it is easie to judge how fit he was for a Traveller; by which Term I don't mean the Common Travellers, but only such in whom is found both a very enlarged Curiosity, which is rare enough, and a certain Gift of Seeing with Discretion, which is yet more rare. The Philosophers seldom run about the World, and those that see most of it, are usually the least of Philosophers; so that the Travels of a Philosopher are extreamly valuable.

We reckon it also a great Advantage to Learning, that *Monfieur Tournefort*, in the Year 1700, received the King's Orders to go into *Greece, Asia, and Africa*, not only to learn the Plants of the Ancients, and perhaps too those that might have escaped them, but moreover to make his Observations upon all the whole *Natural History, upon the Ancient and Modern Geography, and even upon the Manners, Religion, and Commerce of those People*. He was ordered to write as often as he could to the Count *de Pontchartrain*, who procured him all the Conveniences imaginable in his Voyages, and to inform him in particular of his Discoveries and Adventures.

Monfieur Tournefort, accompanied with *Monf. Gundelsheimer* a German, and an excellent Physician, and *Monf. Aubriet*, a skilful Painter, went as far as the Borders of *Persia*, always simpling and observing. Other Travellers into these Parts go

by Sea as much as they can, because it is most convenient for them; and when they travel by Land, they chuse the most frequented Ways; but these Gentlemen made as few Sea Voyages as they could, and wander'd always out of the Common Roads, finding out new ones in the most unaccessible Places. We shall shortly read with, Pleasure and Horror intermixed, the relation of their Descent into the *Grotto* of *Antiparos*; that is to say, into three or four most dreadful Caverns succeeding one another. Monsieur *Tournefort* had the sensible Satisfaction to discover there a new kind of Garden, all the Plants of which were different pieces of Marble, either just produced, or very young; and which according to all the Circumstances that attended their Formation, could not but have vegetated. In vain did Nature hide her self in such Abysses and inaccessible Depths, to work more secretly upon the Vegetation of Stones, since she was, as one may say, taken in the very Fact by these curious and intrepid Virtuoso's.

Africa was included in the Scheme of Monsieur *Tournefort's* Voyage; but the Plague which reign'd in *Egypt*, made him return from *Smirna* to *France* in 1702. this was the first stop he met with.

He returned, as a great Poet says upon a less noble and useful Occasion, *loaden with the Spoils of the East*. He brought back with him, besides an Infinity of different Observations, 1356 new Species of Plants; a great part of which ranged themselves under some of the 673 Genus's that he had established, so that he was only obliged to create for all the rest, but 25 new Genus's, without any augmentation of the Classes, which proves the Convenience

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venience of a System, under which so many exotick Plants, and that were not expected, were so easily reduced. He composed from thence his *Corollarium Institutionum Rei Herbariae*, Printed in 1703.

When he was returned to *Paris*, he thought of resuming the Practice of Physick, which he had sacrificed to his Travels in the *Levant*, at a time when it had begun to be very good : Experience shews that in all things depending upon the Taste of the Publick, and especially things of this nature, Interpositions are dangerous ; the Approbation of Mankind is, as it were, ravish'd from them, and therefore always hastens to an End. Monsieur *Tournefort* therefore found some Difficulty in reviving his Business he had left off ; besides, he was obliged to perform his ancient Exercises in the Royal Garden, to which he joyned those of the Royal College, where he had a Place of Professor in Physick ; the Functions of the Academy did likewise require some part of his Time, over and above all which, he set himself about a Relation of his great Voyage, of which he had only brought back a few short Memoirs and Hints, that no body but himself understood. The Business and Labours of the Day, which made the Nights Rest more necessary to him, obliged him on the contrary, to spend his Nights in new Labours ; and it was his Misfortune to be of a strong Constitution, because he was thereby encouraged to make more bold with himself for a long while, without perceiving any sensible Inconvenience. But at last his Health began to give way, and yet he would not spare it. When he was in this bad Disposition, he received by Accident a violent Blow upon the Breast, of which he himself believed

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believed he should quickly die. After that he did nothing but languish, during some Months, and then died on the 28th of *December*, 1708.

By his Will he left his Cabinet of Curiosities to the King for the use of the Learned; and his Books of Botany to the Abbot *Bignon*. This second Item shews no less than the first, his Love for the Sciences, since the giving them to him who watches for Learning, and encourages it with so much Zeal in this Kingdom, is really making a Present of them to Learning it self.

Of the two Volumes in Quarto, which were to have contained the Travels of Monsieur *Tournefort*, the first was printed at the *Louvre* before he died; and they are finishing the Second from the Manuscript of the Author, which was left so compleat, that nothing could be added to it. This Work, which keeps its first Form of Letters written to Monsieur *de Pontchartrain*, will have 200 Copperplates very well graven, of Plants, Antiquities, &c. and there will appear in it, besides all the Learning that we have hitherto represented, his great Knowledge of Ancient and Modern History, and a vast Erudition, of which we have made no mention, for fear of its looking like Flattery. Oftentimes one predominant Quality makes us neglect others, which however do well deserve to be taken notice of.

His place of *Pensionary Botanist* was filled by Monsieur *Magnol* of *Montpellier*.





The LIFE of Monsieur TSCHIRNHAUS.

WENFROY Walter de Tschirnhaus, Lord of Kislingswald and Stoltzenberg, was born the 10th of April, 1651, at Kislingswald in the upper Lusatia, of Christopher Tschirnhaus and N—— de Sterling, both of them of an ancient Family. It was about 400 Years since the House of Tschirnhaus, which came out of Moravia and Bohemia, had been possessed of this Lordship of Kislingswald near the City of Gorlitz.

Monsieur Tschirnhaus was put under the Care of all those Tutors for the Sciences that are usually allowed to Persons of his Condition, but he answered their Cares quite otherwise than Persons of his Rank were used to do. As soon as ever he had heard that there was such a thing in the World as Geometry, he greedily laid hold of it, and from thence he passed with Rapidity to the other Branches of the Mathematicks, which, by offering him a thousand agreeable Novelties, rival'd each other in his Curiosity.

At the Age of 17 Years his Father sent him to finish his Studies at Leyden, where he arrived at the time of an Epidemical Distemper, which had like to have cost him his Life. Tho' he was so Young he soon attained to a great Reputation among the Learned Men of Holland; but the War breaking out in 1672, he turned Soldier, and shewed that he knew as well how to perform his Duty, as to follow his Inclination. This prevail-
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ing Inclination for Learning, did even contribute towards making him take to Arms; for it was the occasion of uniting him in a strict Friendship with the Baron *de Newland*, who had the same Taste for Letters as he had; and as this Baron was in the Service of the States, he prevailed with Monsieur *Tschirnhaus* to engage himself likewise in the same as a Volunteer, to the end that they might keep together. Monsieur *Tschirnhaus* served eighteen Months, after which he was obliged to return into his own Country, from whence he set out some time after to Travel, according to the Custom of the Gentlemen of his Nation, who are of opinion, that the Knowledge and Correspondence with others is necessary to polish and improve themselves. He travelled through *England, France, Italy, Sicily* and *Malta*; in all the Countries through which he went, he visited the Learned Men, and every thing that is proper to be seen by the Learned, as the Curiosities of Natural History, extraordinary Works of Art, and particular Manufactures.

This great number of different Things, well observed, are not simple Facts, and useless Ornaments of Memory in an Ingenious Man; they become the Principles of an Infinity of Views, to which the finest Theory, void of Experience, could never attain. The more such Eyes see, the more Reason it self sees.

Monsieur *Tschirnhaus* returned to *Germany*, and spent some time at the Court of the Emperor *Leopold*; for a Philosopher may visit even Courts, were it only to observe the Manner and Fashion of thinking there, which he could not so easily discover otherwise.

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In the midst of this agitated way of Living, or at least in a Life sufficiently mingled with Motion, Learning, and especially Mathematicks, always employed our Accademist. He had acquired by Art a Habitude of not being easily disturbed, and had innured himself to Distractions. In the Year 1682, he came to *Paris* for the third time, and brought with him Discoveries, which he was desirous to propose to the *Academy of Sciences*; it was the famous *Causticks* that go by his Name, for we commonly say the *Causticks* of Monsieur *Tschirnhaus*, as we do the *Spiral* of *Archimedes*, the *Conchoid* of *Nicodemus*, the *Cissoïd* of *Diocles*, and the *Cycloid* of Monsieur *Huygens*; and a Geometrician ought to be no less proud of having given his Name to a *Curve*, or to an entire Species of *Curves*, than a Prince of having given his to a City. Monsieur *Tschirnhaus*, tho' he was yet but 31 Years old, was by the King placed among the number of those very Academists whom he came to consult, and in some manner to take for his Judges.

Every Body knows that *Causticks* are Curves, formed by the Concourse of the Rays of Light, which any other Curve whatever has either reflected or refracted; they have one remarkable Property, viz. that they are equal to known Right Lines, when the Curves that produce them are Geometrical; so Monsieur *Tschirnhaus* discover'd that the *Caustick* formed in the fourth part of a Circle, by Rays reflected, which became presently parallel to a Diameter, was equal to the $\frac{1}{4}$ of the Diameter. The Rectifications of the Curves, which at this very time are not common, were much less so then;
and

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and besides, it is a great Merit in this Discovery, to have preceded the Invention of the *Calculation* of the *Infinities*, which would have render'd it much more easie; the Academy judged it worthy to be particularly examined by a Committee, who were Messieurs *Cassini*, *Mariotte* and *de la Hire*; this last contested with Monsieur *Tschirnhaus* a Generation or Description which he gave the *Caustick* by *Reflexion*, of the Quarter of the Circle. Monsieur *Tschirnhaus*, who would not shew the Ground of his Method, did not yield to Monsieur *de la Hire*, and this latter persisted in looking upon the Generation aforesaid as very suspicious; however, the Author of it thought himself so sure, that he sent it to the Journal of *Leipsic*, but without any Demonstration.

He return'd to *Holland*, where he furnished and left in the Hands of his Friends a Treatise, entitled, *De Medicinâ Mentis & Corporis*. He had begun to write at the Age of Eighteen Years, and even with the design of Printing, inseparable almost from that of Composing, of which it is the first Reward. He had made, at several times, some Treatises, with which both his Friends and himself were very well pleased; but by good luck, he had not been able to Print them so soon, so that when he came to Revise them, he was so dissatisfied with his own Performances, that he took a firm Resolution to Print nothing 'till he was 30 Years old, and to sacrifice all the Children of his Youth: A Sacrifice so much the more hard and uncommon, as those Children are born at a Time when one loves with most Zeal, and least Knowledge. The Period which he had prescribed to himself was past, when

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when his first Work, which indeed was the only one Published, appeared at *Amsterdam* in 1687. He Dedicated it to the King, as a Proof of his Gratitude for his Majesty's Favour in making him an Academist. The Title of the Book is, as I may say, double to that of *the Search after Truth*, for the Aim of this latter is only to rectifie or heal the Mind, but the other takes in the Body also. *With good Logick, and good Physick, Men would stand in need of nothing.*

To give an Instance of the Method of leading the Mind thro' the Sciences, by rising always from the more Simple to the more Compound, and by combining together Truths, in proportion to their Birth or Production, Monsieur *Tschirnhaus* proposes an universal Generation of Curves by Centres or Focus's, whereof the number increases always, and at the same time increases the Degree of which the Curve is. He pretends to draw from thence a general Method for the Tangents, in which he mightily glories, and a great many other Theorems and important Problems; and upon this occasion insinuates, that he does not believe himself mistaken upon the *Caustick* of the quarter of a Circle. Monsieur *de la Hire* has since demonstrated in his *Treatise of the Epicycloids*, published in 1694, that this *Caustick* was one of 'em, that indeed it was of the Length determined by Monsieur *Tschirnhaus*, but could not be described in the manner he had proposed: It is no strange thing to make a wrong Step in new Roads, and such as we are forced to open for our selves; an Original Genius, which is warm, bold and lively, may perhaps be not always as wary and circumspect as it ought to

be ; in the Book of Monsieur *Tschirnhaus* one perceives that Fire and Boldness which is peculiar to the Spirit of Invention. If the Author had not done a great deal, one might readily believe that he promises too much, and raises our Hopes too high.

The Precepts of Theory which he lays down are not so singular as certain Practical Instructions that he adds, or rather certain Customs, which he found very useful to him ; we will repeat them here, because nothing can better represent the Detail of his private Life, with respect to his Studies. He made his Experiments in Summer, and in Winter put them in Order, or drew his Consequences from them, or lastly, made great Enquiries in Theory, finding that Season the most proper for Meditation. About the End of Autumn he applied himself to the Care of his Health, and made a kind of a Review of his Bodily Strength, against that Season which he had devoted to the greatest Labours of the Mind. He read over the Compositions of the foregoing Winter, recalling the Ideas hereof, and exciting in himself a desire of continuing them ; and then he began to retrench his Supper Meals, and even to diminish by little and little those of Dinner ; instead of Supper he either read concerning the Matters upon which he had a design to treat, or else discoursed about 'em with some learned Friend. He went to Bed at Nine of the Clock, and was called up again at Two. He kept himself for a while exactly in the same Situation in which the Wakening found him ; this hinder'd him from forgetting what he dream'd of at that instant ; and if, as it might happen naturally enough, his

his Dream turned upon the Matter wherewith his Mind was full, he could more easily proceed upon it. He worked in the Silence and dead of the Night, went to sleep again at Six a Clock, but only till Seven, and then resum'd his Labours. He says, that he never made greater Progress in the Sciences, nor never found himself more Vigorous or nimble, than when he observed all these Methods with the greatest Regularity. One may find in it an excessive Care of managing and improving all possible Advantages; but all great Passions move with a kind of Superstition in relation to their Object.

During the Night, he used to see a great number of very active Sparks, that danced and played about in the Air; when he look'd at them steadily they disappeared, but when he did not mind them, they did not only continue as long as his Application to Business, but their Brightness and Vivacity seem'd to redouble. At last he came to see them in broad Day, after having acquired a certain Degree of Facility in Meditating. He saw them upon a white Wall, or upon a piece of Paper that he placed near him. These Sparks, only visible to him, were at the same time both an Effect and a Representation of the Spirits in his Brain under a violent Agitation.

This Ardent Passion for Learning, gives us naturally enough the Idea of a Man extremely Covetous of Glory; for in short, there are no great Works without great Motives, and the Men of Learning are the Ambitious Men of the Cabinet. However, *Monf. Tschirnhaus* was not so, he did not aspire by all his Vigils to *that Immortality which affects us so much, and belongs so little to us*; and

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he told some of his Friends, that even from the Age of 24 Years, he believed he had freed himself from the Love of Pleasures, Riches, and even of Glory too. Some Men have a right to bear Testimony of themselves; but he loved the Sciences with that pure and disinterested Love, which does so much honour both to the Object that inspires it, and to the Heart that feels it; the manner where-with he Expresses himself in some Places, upon the Raptures produced in him by the Enjoyment of Truth, is so Lively and so Animated, that it would have been unpardonable in him to have expected any other Reward.

The Treatise, *De Medicina Mentis & Corporis*, does likewise contain his Principles upon Health; his attachment to Learning did not so entirely sequester him from the World, but that he found himself sometimes obliged to live with other Men, and after their Manner, and consequently to Eat and Drink too much. He proposes rather some Precautions to prevent the Evils of this kind of Life, than Medicines to cure it, unless you will say that *Sweating*, of which he had a great Opinion, and to which he had always recourse, is at the same time both a Prevention and a Remedy. As for the rest, he looks upon every thing as Poison, that is not Food or Nourishment. He would have us attend to, and follow that simple Taste free from all Reflection, that carries us to certain kinds of Food, or a like disgust which diswades us from it; these things being secret Warnings of Nature, if at least you will allow that Nature takes so much Care of us, and that we may rely so much upon her. He says, that being under an Obligation of Eating much

much, he did eat, at least alternately, things very opposite, Hot and Cold, Salt and Sweet, Sharp and Bitter; and that this Mixture, which seem'd so odd to the rest of the Company, and which they even looked upon as an Effect of Intemperance, served to correct the Excess of the opposite Qualities in the things he fed on. One ought to say for his Honour, that these kinds of Singularities in which the Care of his Health engaged him, were not so great as those occasioned by his Love of Learning.

After the Publication of his Work, being at home in *Saxony*, he began to think upon the Execution of a great Design which he had formed a long time. He was of opinion, that unless we can render Opticks more perfect, our Progress in the Discoveries of Nature, would be confined in a manner within the same Bounds, in which it now is; and that in order to know more of Nature, we must see her better. Besides, he who had been the Inventor of the *Caustricks*, foresaw the larger and better Convex Glasses expos'd to the Sun, would be a kind of new Furnaces, and consequently produce a new Chymistry. But in all *Saxony* there were no Glass-Houses fit to put in Practice these his great Projects. He obtained therefore, of the Elector his Master, the Privilege of setting up one, as they soon perceived how Advantagious it would be to the Country, he established three of them. From thence proceeded Novelties both in *Dioptricks* and *Physicks* almost miraculous. We have given an account of them upon the Word of *Monf. Tschirnhaus*, in our History of the Year 1699 and 1700; some of them were of such a nature as hardly to obtain

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Belief; for in perfecting the *Dioptricks*, they turned them upside down : However, the Burning-Glass which the Duke of Orleans purchased of this Gentleman, is at least an irreproachable Evidence of a great part of what he had advanced.

This Burning-Glass is convex on both sides, and is a part of two Spheres, the Radius of each of which is twelve Foot. Its Diameter is of three *Rhine-land* Feet, and it weighs 160 Pounds, which is an enormous size, with respect to the greatest Convex-Glasses that have ever yet been made. The Sides or Edges of it are as compleatly wrought as the Middle, and that which clearly proves it, is, that its Focus is exactly round. This Glass puzzles the most skilful People, whether it was wrought in Basons, like the ordinary Glasses of that kind, or whether it was cast in a Mould ? We may easily be divided upon the Question, for there are great Difficulties in each manner ; and nothing is a more noble Panegyrick upon Monsieur *Tschirnhaus's* Skill in the Mechanicks than this. He affirms, but perhaps he had no mind to reveal his Secret, that he had cut it in Basons, and that the Mass of that Matter out of which he had taken it weigh'd seven hundred Pounds, which would be yet another Miracle in the Glass Trade. He had made another that was four Foot in Diameter, but it was spoiled by some Accident. He presented a Glass of this kind to the Emperor, who to acknowledge his Gift, and yet more his Merit, would have bestow'd on him the Title and Prerogatives of a Free Baron ; but he declined them with all the Respect that ought to attend such a Refusal ; and of all the Favours offer'd him, he only accepted the

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the Picture of his Imperial Majesty, with a Chain of Gold. To render this Account the more credible, it may not be amiss to support it with a parallel Story. The Elector of *Saxony* offer'd to make him a Counsellor of State, but he refused that Honour likewise. One may suspect that a Man who does not seek after Preferments has a mind either to spare himself a great deal of Pains, or the Shame of not succeeding; but the most ingenious Malice has nothing to say against him, who flies from Honours that come and offer themselves of their own accord to him.

He return'd to *Paris* the fourth time in the Year 1701, and attended the Academy pretty diligently: He there disclosed several Methods, which he had invented for the most sublime Geometry, but he did not demonstrate them; contenting himself to have excited a certain uneasy Curiosity, and perhaps also Doubts, which would have been honourable to his Discoveries, in case they could have been well made out. In our History of 1701, we have given a List of his Proportions. He pretended he could proceed without the Method of the *Infinitely Littles*, and gave the Academy, upon the *Radii of the Cycloids*, a Sketch of what he substituted to it. Nothing can better prove the great Usefulness of the *Infinitely Littles*, than when People pretend not to stand in need of 'em upon certain Occasions. In general Monsieur *Tschirnhaus* would render Geometry more easie, by perswading himself that the true Methods are easie, that the most ingenious are not true, as soon as they become too complicate; and that Nature does every thing in the most simple manner: All this is true; but

the Question is how to determine the Degree of Simplicity ; the Learned think they have now attained to it.

During his stay at *Paris* *Monf. Tschirnhaus* communicated to *Monf. Homberg* a Secret of his own Invention, and as surprizing as that of cutting his Great Glasses ; it was to make Earthen Ware exactly like that of *Cbina*, and which would consequently save a vast deal of Money to *Europe*. It has been thought hitherto, that that kind of Earthen Ware was a particular Favour bestow'd by Nature upon the *Chineses* ; and that the Stuff of which it was composed, was only to be found in their own Country. But it is no such thing ; for it is a mixture of certain Earths, which are commonly found every where besides, but which require some Skill to put together. A first Inventioner does usually fall upon his Secret by chance, and without seeking it ; but a second who seeks for what a first has found, rarely discovers it but by the Strength of Reason. *Monsieur Tschirnhaus* gave *Monf. Homberg* his Porcelain, or counterfeit *Cbina* Ware, for some other Secrets in Chymistry which he received from him, and made him promise that whilst he lived he would make no use of it.

After he was returned home he found himself continually furrounded with domestick Troubles, and his Life was one whole Sequel of Misfortunes. As the Health of the Soul depends upon that of the Mind, on which he had so much meditated, and as a Man of Philosophy is afflicted with fewer Evils, or at least with less painful Evils than another, he supported his with Constancy, and shew'd that which is seldom seen upon the like occasions, the Use

Use of his Theory, and the Application of his Precepts. His Humour was not changed, nor so much as his Studies interrupted. He submitted himself to that Providence which it is in vain to resist, and infinitely more advantageous to submit one self to. At last, after having spent five Years in combating and conquering his Troubles, he fell sick, perhaps because one cannot conquer them so long together without being much weaken'd in ones turn. He was not afraid of the *Fever, Pthysick, Dropsie* or *Gout*, because he made sure he had Medicines for them all, but he very much apprehended the *Stone*, being not so sure, either of preventing or curing it easily. He had however found out a Preparation of Whey, which he thought very good, and which he has published in an Edition of his Book in *High-Dutch*. But that did not hinder him from being attacked in the Month of *September* 1678. with terrible Fits of the Gravel, followed with a Suppression of Urine. The Physicians who did not find him tractable enough because he understood so much of their Trade himself, left him quickly; whereupon he prescribed to himself as he thought fit, and never lost either his Constancy, Resignation to Providence, or Use of his Reason to his Death, which happen'd upon the 11th of *October* following: His last Words were, *Triumph, Victory*. Probably he looked upon himself as Conqueror over the Evils of Humane Life.

He designed the following Winter to have made great Additions to his Book. He had devoted a Considerable part of his Patrimony to his pleasure, that is to Learning. He proposes in his Work, *The Plan of a Society composed of Men of Substance,*

stance, and Lovers of the Sciences, who were to furnish other learned Men of lesser Fortunes, with whatsoever should be necessary to support them in their Studies; and it is easie to see with what Pleasure he would have born his Share in that Community; indeed he bore it without them, making it his Business to seek out Men that were Ingenious in the useful Sciences or Arts: He fetched them out of those obscure Corners, in which they are ordinarily hid, and became at the same time their Companion, Director and Benefactor: He has often taken upon himself both the Care and Charge of printing other Mens Books, from which he expected the Publick might reap any Advantage; among the rest, Mons. Lemery's Course of Chymistry, which he had caused to be Translated into High-Dutch, and that even without attributing to himself in the respective Prefaces, the Honour so justly due to him, and which another would not have slighted in less important Occasions, unless you will say that Vanity does not render 'em all equally Important; he was no less averse to Ostentation: He did good to his Enemies with Zeal, and without their Knowledge, which perhaps Christianity does hardly require: He was not a Philosopher on account of his rare Learning, and a common Man by his Passions and Weaknesses; true Philosophy had penetrated even to his Heart, and had there established that Pleasing Tranquility, which is the greatest, but least sought after of all Goods.

His Place of Foreign Associate was filled by Dr. Sloane, Secretary of the Royal Society in England.

The LIFE of Monsieur POUPART.

F RANCIS Poupert was born in the Country of *Manse*, his Father was an honest Citizen, allied to the best Families in the Town, but had no Employment, and a large Stock of Children; he took great Care of their Education, so that one of em, whom he bred up to the Sea, raised himself by his own Merit, to the Command of a Man of War.

Our Monsieur Poupert perform'd his Studies with the *Fathers of the Oratory* of the *Manse*: The Scholastick Philosophy served only to teach him that Men might Philosophise, and inspired him with the Desire of it. He quickly fell upon the Works of *Descartes*, which gave him a noble Idea of Nature, and also a mighty Passion to Study it. He spent some Years at Home in this only Employment, being uncertain to what Profession he should turn himself; at last he declared for Physick. But wanting both Spiritual, as I may call it, and Temporal Assistance too in the *Manse*, he came up to *Paris*, where it is much more easie to be supplied with both Kinds. He took upon him the Education of a Gentleman's Child for his Subsistence; but perceiving quickly that the Cares of such an Employment took up all his Time, he abandoned it, chusing rather to *Study* than *Live*; that is to say, to the end he might be entirely to himself and his Books, he reduced himself to a very streight and inconvenient manner of Living.

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We are not ashamed to confess openly the mean Condition of our Brethren, nor to expose to the Eye of the Publick, *the Bag and Staff of a Diogenes*, tho' we live in an Age in which such sort of Philosophers are less valued than ever, and in which certainly *they will not be visited by Kings in their Tubs.*

Monf. *Poupart* applied himself with great Industry to the Study of the Physicks, and particularly to *Natural History*; which after all, is perhaps the only Physicks within our reach. A singular Taste carried him to the Study of the *Insects*, a kind of Animals so different from all the rest, and so different among themselves too, that *they make us Comprehend in general the infinite Diversity of the Models upon which Nature may have formed other Animals for an Infinity of other Habitations.* He had both the Patience oftentimes sufficiently painful, to observe them during all the necessary time, and the Art of Discovering their hidden Life, and the Skill of making, whenever it was possible, the nice Anatomy of these little Bodies. He carried his Observations to the Meetings at the late Abbot *Bourdelot's*, where he was one of the principal Actors, they were printed in the *Journal des Sçavans*; witness his Dissertation upon the *Leach*, which was very well received by the Naturalists; for it made known to them a Creature, which all the World fancied they understood before.

To accomplish himself in Anatomy, he was desirous to be employed in the Surgery of the Hospital called *Hotel Dieu*, and offered himself to be examined to that purpose; they interrogated him

him upon the most difficult Subjects, and by the Answers he made them, found that he was very expert in the Art of Surgery; so that they admitted him with Applause. But they were exceedingly surpris'd when he confessed to them that he knew no more of Surgery than only to let Blood, and that all the rest was pure Speculation. They did not repent however of having received him, they judg'd him very Capable of gaining readily and perfectly the Practice of that Art which they were not able to Discover his Want of; and they instructed him with the same Pleasure as Masters do their brightest Scholars. He spent three Years in these Employments, after which he applied himself wholly to Physick; and as he did not seek to streighten the Extent of it, he took in all that had relation to it, as Botany and Chymistry. He took his Doctor's Degree in the University of *Rheims*.

His thirst after Knowledge could not be confin'd within the Bounds of his Profession, as vast as they were. It was no extraordinary thing that the Philosophy of *Descartes* should engage him in a competent Knowledge of Geometry; but one can hardly believe that it should have carried him as far as the Study of Architecture. *Monf. de la Hire*, who professes that Art, has observed him to be very Constant at his Lectures, and knowing him no otherwise, believed that he might be a Man that had some thoughts of applying himself to Building; nor did he so much as guess from the outward Appearances that those Functions to which he might aspire were very Sublime; but he was very much surpris'd, when at the reviving of the
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Academy in 1699, all the Academists that had no Pupils having chosen their respective ones, he found *Monf. Poupart* appearing at the Meetings, as *Pupil* of *Monf. Mery* and *Anatomist*. The Society being then filled with a great Number of new Members, who either had no Works ready to be produced at the Meetings, or else had not Courage enough to produce 'em before such redoubted Judges, *Monf. Poupart* was the first of them all, who found himself in a Condition to speak, and was Master of a noble Assurance to do it. He read a Discourse about *Hermaphrodite Insects*, which was a happy Omen of the Capacity of those among the New ones, that were not yet known to the greatest Number of the *Academists*.

We have seen since among these Volumes which the Academy has published every Year, his History of the *Formica-leo*, that of the *Formica-pulex*, his Observation upon the Fish *Muscles*, and several others less Important, or perhaps only less short. He fell Sick in *October* 1709, and died in a few Days. He is thought to be the Author of a Book entitled, *The Compleat Surgery*; which is only a proper Collection of several other Tracts. If it be so, we ought to excuse him for the Necessity he lay under of doing it, and at the same time applaud him for not Glorifying in such a Collection, of which he had a great number of Examples that might have tempted him.

The LIFE of Monsieur de CHAZELLES.

MON Mathew de Chazelles was born at Lyons the 24 July 1657. His Father was a substantial Merchant: He performed all his Studies in the great College of the Jesuits in that City, after which he came to Paris in 1675, the Passion he had of being acquainted with Men of Merit carried him to the late Mons. du Hamel, Secretary of the Academy, who on his part, did very much encourage all young Persons of whom he could conceive any hopes. And he observed in him a great disposition towards Astronomy; for the Young Man was already a Geometrician; He presented him to Mons. Cassini, who took him along with him to the Observatory; a School in which Hipparchus and Ptolomy themselves would not have scorned to have been Learners.

Theory and Practice always so different, are perhaps more so in the Business of Astronomy than of any other Art whatever, and the most Skilful Astronomer, who is only so in Books, when he comes to handle a Telescope, would be surprized to find that he had hitherto hardly seen any thing; Observations are a very fine and exceeding nice Work: Mons. de Chazelles studied this Art thoroughly, and at the same time made himself Master of all that vast Science of which it is the Foundation. He wrought under Mons. Cassini, upon that great Geographical Map in form of a

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Planisphere, which is upon the Pavement of the Western Tower of the Observatory, and is Twenty seven Foot in Diameter. It was formed upon the Observations which the Academy had already made by the King's Order in different Parts of the World; and that which is most remarkable is, that it is in some manner Prophetical. It contained some very important and anticipated Corrections upon certain Conjectures of *Monf. Cassini*, which have been since verified by incontestable Observations.

In 1683, the Academy continued towards the North and towards the South the great Work of the Meridian begun in 1670. and *Monf. Cassini*, whose Province the South was, associated *Monsieur de Chazelles* to himself in that Undertaking. They extended the Line as far as the Country of *Bourges*.

After having heard *Monf. Cassini's* Lessons at the Observatory during the Space of five Years, *Monf. de Chazelles* could not but be himself a great Master. The great Duke *de Mortemar* took him to teach him the Mathematicks, and carried him into the Country of *Gennes* in 1684, and procured him the following Year a new Employment of Professor of Hydrography for the Gallies at *Marseilles*; for there had been a long time since, an old one filled by one of the Fathers *Jesuits*, to whom it was necessary to give a Coadjutor, the Marine Affairs of *France* having been considerably increased.

These Schools are kinds of little States, and hard enough to be managed. All the Subjects which compose them are in the Strength of their youth;

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youth; Impetuous, Indocile, vehemently fond of Independance, Enemies almost irreconcilably to all Application, and that which is worst of all, they are all Military Men; but their Master has no Military Power over 'em. Nevertheless Monsieur *de Chazelles* had the Reputation of being always respected, and even loved by these his redoubtable Subjects.

He had that steady and couragious sweetness of Temper, which knows how to win Hearts with Dignity. The Success he had here, encouraged him to undertake another new School of young Pilots, destined to Serve in the Gallies: From this School has proceeded, and does still proceed daily, a great Number of good Seamen.

During the Summer of the Year 1686, the Gallies made four little Campaigns, or rather four little Tours, in which they only proposed to perform their Exercises. *Monf. de Chazelles* went with them each time, and kept his Schools upon the Sea. He shewed the Officers the Practical part of what they had only learnt before in Theory. He made likewise several Geometrical and Astronomical Observations, by which he was enabled to Publish afterwards a New Chart of the Coast of *Provence*.

We take no notice of two Campaigns, tho' more long and more considerable, which he made in 1687, and 1688. both of them produced a great number of Plans, and Draughts, either of *Ports* and *Roads* where he landed, or of Places that he had an opportunity of seeing. It is well known, that such Draughts are not simple Curiosities, and that being deposited in the Hands of Ministers of State,

State, they become in certain Seasons, Subjects of the most important Deliberations, which are regulated by them with so much the greater Certainty, as they have been performed by a good hand.

It is long since, that Experience, the supream Mistress of all the Arts, has made a Division between the two Kinds of the great Vessels belonging to the Seas, and all the People of *Europe* have approved of it; to the *Ocean* it has allotted the *Frigates*, to the *Mediterranean* the *Gallies*. These latter draw too little Water to withstand the mighty Waves of the Ocean. But the former also have that essential Defect, that they are useless without the Winds; they are great Bodies, entirely depending on that foreign and unconstant Soul, by which they are sometimes quite forsaken. At the beginning of the last War, some of the Sea Officers, and *Monf. de Chazelles* with them, were of opinion that we might make use of the Gallies upon the Ocean, that they might be there used to tow the Frigates, when the Wind either failed, or was against them; in a word, that they would render them independant of the Winds, and consequently much more useful than those of the Enemy: They might likewise secure and defend our Western Coasts. These sort of bold Notions, provided they be contained within certain Bounds, proceed from a Courage of the Soul, uncommon, even among those who have a brave Heart. Without such boldness, a false Notion of Impossibility would mix it self almost with every thing. As *Monsieur de Chazelles* had a great share in the Project, he was sent into the West in *July* 1689, to view the Coast with respect to the Navigation of the Gallies; finally in
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the Year 1690, fifteen new built Gallies sailed from *Rochefort* almost wholly upon his Word, and afforded a new Spectacle to the Ocean. They went as far as *Torbay* in *England*, and were made use of in the Landing at *Tinmouth*; *Monf. de Chazelles* did there perform the Office of Engineer, very different from that of Professor of Hydrography, tho' he was not destined to the War, and tho' it be not natural for a Soldier to be bred up in the Observatory; he shewed upon this and several other the like occasions, all the Intrepidity which the profession of Arms requires. The General Officers under whom he served, have attested, that when they sent him to view any of the Enemies Posts, they could entirely rely upon the Report he made them. It happens but too often, that those who are charged with these sorts of Commissions, do not all of 'em either carry with them, or keep a very exact view of things. *Monf. de Chazelles* was only originally a Man of Letters, but the Sciences themselves had made him a Military Man; that which raises the Mind ought always to exalt the Soul too.

The Gallies after their Expedition returned to the Mouth of the *Seine*, into the Basons of *Havre de Grace* and *Honfleur*, but they could not Winter there, because it was necessary to drain those Basons from time to time, to avoid the Corruption of the Waters. *Monsieur de Chazelles* proposed to carry the Gallies up as high as *Roüen*, all the Pilots found unsurmountable Difficulties in doing it, he alone maintained his Project, and he had acquired to himself great Trust and Confidence, they believed him, and the Gallies went up very luckily. A great Ca-

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capacity and Understanding do not alone suffice to render a Man bold enough to take upon himself any considerable Event; there must likewise concur a lively Zeal, to support him under the Injustice of Mankind, always disposed to withdraw their Approbation from every great Design, that is not attended with Success.

Thus the Gallies winter'd at *Rouën*, and it was the Business of him that brought them thither, to preserve them from all such Accidents wherewith they might be threatned, in this their new and strange Habitation. He therefore projected a new kind of Moorings, and a little row of Stakes, which secured them from the Frosts that they were to expect, and this he did at a small Charge, whereas any other Method would have been very Expensive.

Whilst he was at *Rouën*, he digested the Observations he had been making upon the Western Coasts, and compos'd out of them eight particular Charts, accompanied with a *Portulan*, that is to say, an ample Description of each *Port*, or the manner of coming into it, of the kind of Anchorage, of the Tides, of the Dangers, of the Discoveries, &c. These Sorts of Works, when they are in their utmost Perfection, are of very great Value, because the Practical Sciences are the least advanced of any.

Two or three great Genius's may suffice to carry Theories very far in a short time; but Practice proceeds much more slowly, because it depends upon a great number of Hands, the greatest part of which are the least able. The new Charts of *Monf. de Chazelles* were published in the *French Neptune*,
in

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in 1692, that same Year he made the Campaign of *Oneille*, and served as Engineer at the Landing there.

In 1693. *Monf. de Pontchartrain*, then Secretary of State for the Sea Affairs, and now Chancellor of *France*, having resolved upon publishing a Second Volume of the *French Neptune*, which was to include the Mediterranean Sea ; *Monf. de Chazelles* proposed to go and settle, by Astronomical Observations, the exact Position of the Principal Points of the *Levant*, and required but a Year for his whole Voyage. It would have been hard to have refused him a Favour for which he had so few Competitors ; he parted, and ran thro' *Greece, Egypt and Turkey*, with the Quadrant and Telescope in his Hands. It is true, that this is only a continual Repetition of the same Operations, without acquiring new Lights ; whereas the Learned Man that keeps in his Study, daily gets new ones with Extasies and Transports of Pleasure ; but the more such Pleasure soothes us, the more noble it is to Sacrifice it to the Service of the Publick, which is more benefited by some Facts well ascertained, than by many shining Speculations.

This Voyage of *Monf. de Chazelles*, afforded an important and long expected Discovery in Astronomy. It is necessary for the Perfection of this Science, that the Astronomers of all Ages should transmit their Observations down to Posterity, and give one another their helping hand ; but to be able to make a right Use of the Labours of the Ancients, we must calculate for the Place where we are, what they calculated for their respective Places ; and consequently know exactly the Longitude and Latitude of those Places. We must not too much depend upon

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the Ancients themselves for it, because we observe at present with such Instruments, and so much Exactness, as they were incapable of, and which render all other Methods a little suspicious. The Astronomers, whose Observations it was most necessary to compare with ours, were *Hypparchus*, *Ptolomy* and *Tycho-Brabé*; the two first were of *Alexandria* in *Egypt*, and they made that City the Capital of Astronomy. *Tycho* was in the Isle of *Huene*, scituate in the *Baltick-Sea*, where he built that famous Observatory, which he called *Uraniburg*. The Academy, at the very Birth of it almost, had formed the noble Design of sending Astronomers to *Alexandria* and *Uraniburg*, to carry on the Thread of the Work of those great Men that had begun it there. But the Difficulties that were like to attend the Voyage of *Alexandria*, made them confine themselves to that of *Uraniburg*, which *Monf. Picard* was contented to undertake in 1671.

He there drew the Meridian of the Place, and was very much surpris'd to find it differ 18 min. from that laid down by *Tycho*, and which he could not have established carelessly, because it was necessary to fix a Term or Point, to which all his Observations might be referr'd; this would make one believe that the Meridians vary'd, that is to say, that the Earth does not always turn upon the same Poles; for if another Point becomes a Pole, all the Meridians that ought to pass through that new Point, must necessarily have changed their Position. We see therefore of how great Importance it is to the Astronomers, to make themselves certain either of the Variation, or of the Invariability of the Poles of the Earth, and of the Meridians.

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Monsieur *de Chazelles* being in *Egypt*, measured the *Pyramids*, and found that the four Sides of the biggest, were exactly opposed to the four Regions of the World. Now as this so exact Opposition ought, according to all possible Appearances, to have been affected by those who raised this great Mass of Stones above 3000 Years ago; it follows, that during such a long space of time, nothing in the Heavens had varied in this respect, or which is the same thing, in the Poles of the Earth, or in the Meridians. Can one imagine that *Tycho*, so able and so nice an Observer, did draw his Meridian wrong, and that the Ancient *Egyptians*, so dull in these Matters at least, drew theirs right? The Invariability of the Meridians has been yet further confirmed, by that which *Monf. Cassini* drew in the Year 1655, in the Church of *St. Petronia* at *Bologna*.

Monsieur *de Chazelles* brought back likewise from his Voyage into the Levant, all that the Academy desired to know concerning the Position of *Alexandria*. Wherefore *Monf. de Pontchartrain* thought there was due to him a Place in that Society, to which his Labours had been so useful. He was accordingly admitted in 1695, and then returned to *Marseilles* to resume his former Functions.

All the rest of his Life was little more than a perpetual Repetition of what we have hitherto seen; Campaigns by Sea almost every Year, either in War or Peace, some of 'em only considerable (as that of the Year 1697, in which *Barcelona* was surrender'd) from the Positions he took of all the Places he saw, from the Draughts he made, from the

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Functions of Engineer which he often performed, and with Honour too, and at last, from a peaceful Return to his School at *Marseilles*. He did not despise this latter, because he had been employed upon more shining Occasions, nor would he ever think of leaving it. *The greatest Souls are such as adapt themselves best to the present Situation, and exhaust themselves least in remote and future Schemes.*

In the Year 1700, when *Monf. Cassini*, by the Kings order, went to continue towards the South, the Meridian forsaken, in 1683, *Monf. de Chazelles* was appointed to go along with him, but did not overtake him till he came to *Rhodes*, and there *Monf. de Chazelles* applyed himself so earnestly to that Work during the worst Season of the Year, that his Health began to be considerably impaired by it.

The Line having been carried as far as the Frontiers of *Spain*, he returned to *Paris* in 1701, where he was Sick or Languishing above a Year. It was then he communicated to the Academy the vast Design he had projected of a general *Portulan* for the Mediterranean. One may conclude, that in the Geographical and Hydrographical Maps of the three Quarters of the Globe, there is as yet but an imperfect Sketch taken of the Earth; and that even in *Europe* it self, the other Quarter, it is far from being quite finished, or very near it, tho' there has been a great deal of Pains taken in it.

Notwithstanding a great many distracting Cares, and his Infirmities too, the greatest of all Cares, *Monf. de Chazelles* would not lose sight of his Gallies wandering in the Ocean. Being at *Paris* in 1702, he proposed that they should lie dry in all the

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the Havens where there was Tide enough to carry them in, by that means he trebled the number of Occasions in which they might be employed. They tried his Project at *Ambleteuse* upon two Gallies, which they ran ashore, and it bore it fifteen Days without any Inconvenience. On the contrary, it afforded a very great Convenience of cleaning them. *One must be bold in all Projects, but the Difficulty is to be bold with Discretion, which is next to reconciling Contradictions.*

The Nine last Years of the Life of Monsieur *de Chazelles*, tho' as laborious as all the rest, were almost always languishing, and his Health continually impairing. At last he was seized with a Malignant Fever, which he slighted at the beginning, either from the habitude of Suffering, or from the little opinion he had of Physick, to which he prefer'd the strength and help of Nature. Finally, he died the 16th of January 1710, in the Arms of Father *Laval* a Jesuit, his Colleague in Hydrography, and his intimate Friend. *When two Men are Friends in Posts that naturally makes them Rivals ; one need not require any other Proofs of Equity, Sincerity, or even of Generosity.* To these good Qualities, and all the rest which we have already represented, *Monf. de Chazelles* always joyned a great stock of Religion, which only secures and strengthens all other Virtues.

His place of Associate Academist was filled by Monsieur *Ozanam*.



The LIFE of Monsieur GUGLIELMINI.

Geminus *Guglielmini* was born in *Bologna*, of a good Family, 27th September 1655. He Studied the Mathematicks under *Monf. Geminiano Montanari* a *Modenese*, and *Phyſick* under the *Illuſtrious Malpigbi*. He embraced theſe two Sorts of Studies at the ſame time, and with the ſame Facility, as a Man born with happy Diſpoſitious would have applied himſelf to one only, and was as much beloved by both his Maſters, as if each alone had had the Honour of his Education.

In 1676, there appeared in moſt parts of *Italy* a Meteor as luminous as the Moon at full; *Monf. Montanari* compoſed a little Treatiſe about it, entitled, *Fiamma volante*, wherein, by the Obſervations he had received from ſeveral Parts, he enquired Geometrically what was the Line of Motion of the ſaid Meteor, its Diſtance from the Earth, and its Bigneſs. According to his Computation, its diſtance was fifteen middling French Leagues, which is an extraordinary Heighth for this kind of Fires. *Monf. Cavina*, who had obſerved the ſaid Phenomenon at *Faenza*, made a very different Calculation of it; the Heighth where he placed it, for inſtance, was treble to that of *Monf. Montanari*, and beſides this latter in his Book, having ſlighted the Obſervations of *Faenza*, not by rejecting them with Contempt, but in ſaying, that he was very ſorry to find them ſo different from all the reſt, and that
probably

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probably the Mistake proceeded from those that had communicated them, and to whom there had been too much Credit given; this Complaisant manner did not hinder *Monf. Cavina* from returning a sharp Answer to *Monfieur Montanari*, who seeing that their Dispute was like to degenerate into Reflections and Injuries, had bravery enough to declare publickly, that he renounced it. *Monf. Guglielmini*, who was then but 21 Years old, and as zealous a Disciple of *Montanari* as the late *Monf. Viviani* was of the famous *Galileo*, (for these sort of Attachments seemed to be strongest in *Italy*) desired his Masters leave to answer for him; *Monf. Montanari* refused him, lest his Adversary should think that the Master was concealed under the Scholar's Name; *Monsieur Guglielmini* however prevailed at last, and got leave to maintain some Publick Thesis, where *Monf. Montanari* should not be present, and where *Monf. Cavina*, whose Opinion was attacked, should be invited, and staid for during a certain time; he came not, but treated the Challenge as a Duel would be 'treated in *France*, and he was in the right of it, it seems, for *Monf. Guglielmini*, tho' he declares that he was not yet got through the *Conick Sections*, overthrew his Enemy in the Science of Geometry; there were a good many Writings passed between them, and some of 'em much larger than the Case in reality required; *two or three Pages might have sufficed to unfold the Truth, but Mens Passions swell them into great Bodies.*

Monsieur Guglielmini took his Degree of Doctor of Physick in the University of *Bologna* in 1678, but in the midst of that Application and Study, which

which such a laborious Profession requires, a new Phenomenon that appeared in the Heavens called him away again for a while to the Mathematicks. It was the Comet of 1680, and 1681, which, by I know not what particular Fate, put the learned World in a greater Ferment than any other had done. The Sentiments of those who maintain that Comets are Eternal Bodies as well as Planets, had been attacked by Mons. *Montanari* upon this Ground, that this last Comet which disappeared at the end of February, 1681, was not then so very remote from the Earth, as to disappear on account of its distance only, and consequently that there must have happened some natural Dissolution; this reason, which did not carry the Force of Demonstration with it, appeared so however in some sort to Mons. *Guglielmini*, because it came from a Master that was so dear to him, and it put him upon looking out for an Hypothesis, to explain the Generation of Comets. He fancied one that was singular enough, upon which he formed a Work, entitled, *De Cometarum natura & ortu, Epistolica Dissertatio Bononiæ, 1681.* He allows very great *Vortexes* to the Planets, so that those, for instance, of *Jupiter* and *Saturn*, whose Centres are distant 165 Millions of Leagues, when they come as near one another as possible, may cross each other towards their Extremities. In this Interfering and Embarrassment of the Matter of the two *Vortices*, there is form'd, by vertue of the opposite Motions, a new *Vortex*, of which the greatest Parts (for the Heavenly Matter is not all Homogenous) subside, and take the place of the Centre, producing a new solid Body, which is the Head of the Comet.

We

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We shall not relate either the Proofs or the Difficulties of this System; the Author himself declaring, that he does not affirm it to be true, or even probable, but only proper to explain the Facts, and he proposes it with such a Modesty, as atones for its Weakness, and disarms the Criticks.

He gave new Testimonies of his skill in Astronomy, by the Observation he made at *Bologna* upon an Eclipse of the Sun, that happened the 12th of *July*, 1684; and which he published in Latin the same Year.

The Merit of *Monf. Guglielmini* was confessed even in his own Country: The Senate of *Bologna* made him First Professor of the Mathematicks, and in the Year 1686, gave him the general Superintendency of the Waters of that State. Travellers tell us, that in *Persia* the Office of Superintendent of the Waters is one of the most considerable, because of the dryness of the Country, and the difficulty of Watering all sufficiently and equally; by a quite contrary reason, this Employment is of the same Importance in the *Bolognese*, and in general throughout *Lombardy*, where the great Quantity and Disposition of the Rivers and Canals, otherwise so profitable to the Country, may nevertheless produce great Inconveniencies, unless they be continually upon the watch, and that with understanding Eyes too.

Monf. Guglielmini had that uncommon Scrupulosity of considering his Employment, not like one of those Commissions which are always well enough discharged by a general Knowledge of the Affair, and in which it is sufficient if one spoils nothing; but as a very serious Engagement, which was to engross

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engross all his Thoughts, and by which he was to serve the Publick with the utmost Exactness.

Wherefore in the Year 1690, he published the first, and in 1691 the second part of a Treatise of *Hydrostaticks*, entitled, *Aquarum fluentium mensura, novâ Methodo inquisita*; and Dedicated it to the Senate of *Bologna*. His fundamental Principle, which is likewise that of all the Modern Philosophers, is, *that the Swiftnesses of a Water proceeding from a vertical or inclined Tube, are at each instant, as the Roots of the Heights of its superior Surface*, which necessarily introduces the Parabola in this whole Matter. Even when the Water runs thorow a Horizontal Canal, which may be, provided that it has an Issue to discharge it self, the Principle is still the same, because the Upper Water pressing upon the Lower, communicates to it a Swiftness proportionable to its Depth.

To find Geometrically, in a Horizontal Canal, the middle Swiftness between that of the Bottom, which is the greatest, and that of the Superfices, which is the least, we see presently by the squaring of the Parabola, that that Swiftness is always in proportion to the Bottom, as Two to Three, and that it is always placed at $\frac{2}{3}$ of the Depth of the Canal, divided from the Top to the Bottom.

When one has made a Fundamental Experiment upon the Swiftness of the Water; as for Example, that of *Monf. Guglielmini*, by which he found that a Water descending the Depth of one Foot of *Bologna*, ran in one Minute, two hundred and sixteen Foot, five Inches, with an equal Motion, one knows then its Swiftness for all possible Falls; and he has calculated a Table for that purpose, which he
does

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does not carry beyond thirty Foot of Descent, because the greatest *Rivers* in *Europe* do not exceed that Depth. If one would measure the Quantity of Water, which passes in one minute thorow a Horizontal Canal, knowing that its middle Swiftness is as $\frac{2}{3}$ of its Depth, one must reduce those $\frac{2}{3}$ into Feet and Inches. Then one finds by the Table, what Fall or Pressure is requisite to such a Depth, that's the middle Swiftness of the Water, and multiplying it by the Breadth and Depth of the Canal, one has the Quantity of the Water demanded. *Monf. Guglielmini* finds by this Method, that the *Danube*, supposing it Horizontal at its Mouth (as are almost all the great Rivers at least sensibly) discharges into the *Euxine* Sea in one minute, near forty two Millions of *Bolognese* Cubical Feet of Water.

For the inclined Canals there is only required a little more Calculation, and the Knowledge of the Angle of Inclination of the Canal, after which all the rest is alike.

This is the general Idea of the whole Work ; it is very exact and methodical. Only perhaps it may appear a little prolix to such as have the Taste and Habitude of that Algebraical Brevity, which, in the Business of the Mathematicks, may be properly compared to what we call a close Stile in Eloquence and Poetry : But every Author writes chiefly for his own Country ; and tho' *Italy* may be accounted, at least as to *Europe*, the Cradle of *Algebra*, that Science had not yet made any great Progress in the Time of *Monf. Guglielmini*, but flourished much more in the Northern Climates.

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The Transactions of *Leipsic* for the Year 1691, having given some account of this Book about the *Admeasurement* of the *Waters*, Mons. *Papin* made some Remarks and Objections upon the Extract that he there met with, and caused them to be inserted into the same Journal. Of this Monsieur *Guglielmini* received some general Notice by Letters from Mons. *Leibnitz*, before those Transactions could reach *Italy*. At the Name of Mons. *Papin*, he began to fear he had been mistaken; for it is not to be doubted of, after the Confession he made of it himself, unless those who understand true Glory, will look upon so honourable a Confession as a little suspicious. He received at last the Transactions of *Leipsic*, and took Courage thereupon, and writ to Mons. *Leibnitz*, to make him Judge of the Difference.

Monsieur *Papin* believed, and pretended he could demonstrate, that the Water that comes out of a Tube always full, has but half as much Swift-ness as the first Water which comes out of the same Tube emptying it self: His reason was, that in the former Case the Water has only an equal and uniform Motion, whereas in the Second it has an accelerated Motion, since it falls, or is supposed to fall; Monsieur *Guglielmini* confuted that Hypothesis with all the decency and civility which became a Man who sincerely believed himself capable of Erring. It appears by his whole Letter, that the Victory was entirely on his Side; and yet it appears likewise, that there was something in that matter which he had not unravelled, and which escaped his Accuracy. The Swift-nesses of Water are as the Roots of the Depth, there being exactly between them the same Relation as between
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the Swiftnesses of heavy Bodies descending ; the two Adversaries, and all the other Philosophers, had imbibed this very natural Idea, that the Swift-nesses of Water depend upon an Acceleration occasion'd by a Fall ; but we have shewn, after Monsieur *Varignon*, in our History of 1703, that as natural as this Idea is, it is not true ; and that there is another Principle of this relation of the Swiftnesses of the Water quite different from the Acceleration, and at the same time so plain and simple, that it would not do much Honour to the Inventer of it, if it had not been so long concealed from the most able Geometricians. For want of knowing this Mons. *Guglielmini* could not avoid certain Difficulties, out of which he endeavours to extricate himself by the Pressures of the Air. *It does not suffice to have discover'd a Truth, but one must likewise, if one would carry it a good way, trace its true Cause ; otherwise the false Cause of a Truth begets Errors, its Natural Production.* Mons. *Guglielmini*'s Letter to Mons. *Leibnitz* was followed with another in 1691, directed to Monsieur *Magliabecchi*, about the Syphons ; because he had found in the Acts of *Leipsic*, that Monsieur *Papin*, in examining a Syphon made at *Wirtemberg*, had made use of his false Proposition. Those two Letters were printed under the Title of *Epistolæ duæ Hydrostaticæ*.

About that time there arose a Difference between the Cities of *Bologna* and *Ferrara* ; the chief Question was, to know whether the Course of the *Reno* should be turned into the *Po* ? The Pope, who was Sovereign of both those States, sent the Cardinals *Dada* and *Barbarin* to decide that Affair.

Bologna

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Bologna referr'd its Concern to *Monf. Guglielmini*, the sole Person capable of transacting it. The two Cardinals with whom he treated, conceived so great an opinion of his Capacity, that they employed him not only for the Waters of the *Bolognese*, but likewise for those of the *Ferrarese*, and of the Territory of *Ravenna*, and engaged him in Plans of different Works, either useful or necessary. But it then happen'd to him as we have already said it did to *Monf. Viviani* on the like Occasion, for Projects which only relate to the Publick, are seldom put in Execution.

As *Monf. Guglielmini* had carried the Science of *Waters* farther than any one else, at least in *Italy*, and as he had formed a Science almost new about it, the City of *Bologna*, in the Year 1694, founded a New Chair of Professor of *Hydrometry* in its University, and gave it to him. The Name of *Hydrometry* was as new as the Office, and both of them will always bring to mind the Name of the Man who render'd this Establishment necessary.

He allowed himself however to be diverted sometimes from the study of the Waters, upon Occasions in which it had been difficult to resist the Call of other Sciences. When *Monsieur Cassini* return'd to *Bologna* in 1695, and mended the famous *Meridian*, which he had drawn there forty Years before, in the Church of *St. Petronia*, and which several Accidents had changed, *Monf. Guglielmini* assisted him in that great Philosophical Labour; and did likewise print an Account of the Operations that had been made for the Construction and Verification of that prodigious Instrument.

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strument. He made use of it since during several Years, in observing the Motions of the Sun and Moon.

In 1697, he published his great Work of *the Nature of Rivers* in *Italian*, which passes for his Master-piece, and Dedicated it to the Abbot *Bignon*, who the Year before had caused him to be chose a Member of the *Royal Academy of Sciences*, and whose Name and Merit, without such particular Favours, has often induced even Foreign learned Men to pay him the like Homage.

The Subject of his Preface is upon the necessity of reducing Physicks to a Geometrical Certainty, and upon the Difficulty, often unsurmountable, of introducing the simple Idea's of Geometry into so complicated a Science as that of Natural Philosophy.

A common Naturalist will not doubt perhaps that he does not sufficiently understand the Nature of Rivers ; but after having read *Monf. Guglielmini's* Book, he will be convinced that he knew nothing of it. We will only give you here a general Sketch of that Treatise, and leave you to judge what the different Combinations of Principles and Applications to particular Cases may produce.

Rivers near their Springs commonly descend from some Mountains, and there they take their Swiftness from the acceleration of their Fall ; but in proportion to their Distance from the Spring, that Swiftness grows less, because the Water always rubs against the Bottom and the Sides of its Channel, because it met with several Obstacles in its way, and lastly, because when it glides along the Plains, its descent always decreases, and it inclines more to-

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wards

wards the Horizon. The *Reno* is scarce inclined to it above fifty two Seconds towards the end of its Course. If the Swiftneſs acquired by the Fall ſhould be quite loſt, which may happen ſometimes by meeting with ſeveral Obſtacles, and the Courſe of the River become altogether Horizontal, there is nothing but the Depth of it, or the preſſure always proportioned to the Depth, that can reſtore its Swiftneſs and make it run. Happily this reſource increaſes according to the Want of it; for in proportion to the loſs of the Swiftneſs acquired by the Fall, the Water riſes and increaſes in Depth.

The upper Parts of the Water of a River, which do not touch the Banks, may run only by vertue of the Declivity, tho' that be never ſo ſmall; for being hinder'd by no Obſtacle, they may be nicely ſenſible, as one may ſay, of the leaſt difference of the Level; but the lower Parts, which rub againſt the bottom, could not be ſufficiently moved by ſo ſmall a Declivity, nor would they run without the concurrent preſſure of the upper Parts.

The natural Viſcoſity of the Parts of Water, and a kind of Tenacity which they have with one another, is the cauſe that the lower Parts being moved by the Depth, draw the upper with them, which in a Horizontal Channel would not have had any Motion of themſelves, or would have had but a little in a Channel but little inclined. Thus the lower do in this caſe reſtore to the upper ſome part of the Motion they had received from them. From thence it likewise happens, that very often the greateſt Swiftneſs of a River is about the middle of its Depth; for the Parts in the
middle

middle have the advantage of being pressed by the half of the Water above them, and of being free from the Friction of the Bottom.

To know whether the Water of a River that is almost Horizontal, runs by the Swiftneſs acquired from its Fall, or by the preſſure of the upper Parts, you need only oppoſe to its Courſe a perpendicular Obſtacle; for if the Water raiſes it ſelf ſuddenly againſt the Obſtacle, then it ran by virtue of its Deſcent; but if it ſtops a while, then the preſſure was the Cauſe of its Motion.

Rivers do almoſt always make their own Bed, in which, if there be at firſt a great Declivity towards the Bottom, the Water that will conſequently have a greater fall and ſtrength, will carry away the moſt exalted part of the Ground, and by that means render the bottom more even and horizontal; 'tis under the Stream of the Water that the greateſt ſtrength of Friction or of wearing lies, and conſequently 'tis there that the Bottom is render'd moſt hollow. The Water that makes its Bed moſt horizontal becomes ſo likewise it ſelf, and thereby has leſs Strength of wearing; and that Strength being at laſt ſo far diminished, as to be only equal to the reſiſtance of the Bottom, it is reduced to a ſtate of Conſiſtance, at leaſt for a conſiderable while. The Bottoms that are compoſed of Chalk reſiſt more than thoſe that are of Sand or Mud.

On the other hand, the Water wears away and undermines its Sides, and with ſo much the more force, as by the Direction of its Courſe it finds them more perpendicular. Wherefore by wearing and rubbing them, it tends to render them

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more parallel to its Course, and when it is come as far as it can towards that Point, it has no farther action over them in that respect. At the same time that the Water wears away its Banks or Sides, it enlarges its Bed, but loses in its depth and strength proportionably, 'till at last there is an *Equilibrium* between the strength of the Water, and the resistance of the Sides, and then its Bounds are settled.

It is plain by Experience that these Equilibriums are real, since Rivers do not dig and enlarge their Channel for ever.

The contrary of what we have said does likewise happen; Rivers whose Waters are troubled and muddy, raise their Bed by the subsiding of the foreign Matter mixed with them, when they can no longer support it, they likewise narrow their Borders by the Accession and Incrustation of the same Matter on the Sides of them. This Matter being driven far from the Stream of the Water, by reason of its little Motion, may likewise contribute towards the making of Banks; these contrary Effects meeting almost always together, and combining very differently, according to the particular Degrees of them, it is not easie to guess at the Result; nevertheless one must find out, as exactly as possible, this entangled Combination, if one has to do with a River of which for instance, one intends to turn the Course. One may conclude that it will always act according to its Nature, and that it will accomodate it self with a Bed, and work out such a Course as will be agreeable to it. *Monf. Guglielmini* relates, that at the beginning of the last Century, the River

Lamone

Lamone, which fell into the *Po di Primaro*, was turned from it; to the end that it might discharge it self alone into the *Adriatick* Gulph.

It happen'd that the *Lamone* being become more weak when it had only its own Waters, raised its Bed in such a manner by the subsiding of its Mud and Slime, that it was higher than the *Po* in its deepest places, and stood in need of very high Banks.

The Necessity of making Banks or Dykes to Rivers may arise from several Causes. These are the Principal. First, if the Rivers are winding, the Banks which stop them at the Point of their sinuosity or winding, raise their Waters, and by that means contribute to their Strength of undermining and piercing the said Banks, and so to the Overflowing of the Country. Secondly, the Banks may be weak, as are those which Rivers make for themselves by the Deposition of the Foreign Mud which they carry along with them; such are the Banks of most of the Rivers in *Lombardy*, where not only the Dykes, but even the Plains themselves have been formed by the Rivers. It is good to observe that the Plains thus made by *Alluvion*, are highest next the Sides of the Rivers that produce them, and always afterwards lower. Thirdly, the Rivers that run upon a very coarse Gravel are Subject to bring great heaps of it together, which at last help to turn their Course. They are most commonly ungovernable; witness the *Loire*: Whereas, those which have a Bottom of light Sand are much more easily managed.

A small River may fall into a greater without increasing either its Breadth or Depth; this ap-
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pearing Paradox, is founded upon the Possibility that the small River may do nothing more but put in motion the Waters of the greater, next the Banks which were stagnant before, and likewise increase the Swiftness of the Stream; and that it does to the whole, in proportion as it augments the Quantity of the Water. That Branch of the *Po*, that belongs to the State of *Venice*, has swallowed up the two other of *Ferrara* and *Panaro*, without any increase of its Bed.

We must account in the same manner proportionably for all the Additions to other Rivers, and in general for every new Augmentation of Water, which at the same time increases the Swiftness of the Stream.

If a River which presents it self to fall into another River, or into the Sea, be not strong enough to surmount the Resistance it meets with, it would presently swell, either because its Swiftness is diminished, or because the Waters that should have received it are disgorged back again into it; but by that very swelling it would require a Strength sufficient to make its Way; nay, it would even receive it from the very Opposition it met with.

A River that falls perpendicularly into another, or even against its Current, will by little and little be turned away from that Direction by the River which receives it, and obliged to make it self a new Bed towards its Mouth.

The Union of two Rivers occasions a swifter Stream afterwards; First, because instead of rubbing against four Banks, they have only two to surmount; Secondly, because the Stream being at a greater distance from the Banks moves more
swiftly;

swiftly, and *Lastly*, because a greater quantity of Water moved with more Swiftneſs deepens the Bottom more, and leſſens the former Breadth. From hence it likewise proceeds, that united Rivers occupy a leſſer ſpace of the Earth's Surface, ſuffer more eaſily the lower Meadows to diſcharge their ſuperfluous Waters into them, and have leſs occaſion for Dykes to fence againſt their Inundation. Theſe Advantages are ſuch as Monſ. *Guglielmini* thinks worthy to have been premeditated by Nature, when ſhe made the Union of Rivers ſo common.

Theſe are the moſt general Principles of his Book about the *Nature of Rivers*, and they are applied by the Author to every thing that he calls *the Architecture of the Waters*, that is to ſay, to all ſuch Works as have the Waters for their Objects, to the new Communications of Rivers, to Canals that are made for Watering the Lands that ſtand in need of 'em, to Sluices, to draining of Fens and Marſhes, &c.

This Book, an Original in its kind, made a great Noiſe. *Cremona*, *Mantoua*, and ſome other Cities, had recourſe to the famous Architect of the Waters: He order'd the Works that were neceſſary for them; but his Art ſhined chiefly in the Banks that he made for the *Po* below *Piacenza*, where this River made great Havock, and threatned much more.

The Common-wealth of *Venice* envying the Happineſs of *Bologna*, called him in the Year 1693, to the Profeſſorſhip of the Mathematicks at *Padoua*. However his own Country to keep him hers as much as 'twas poſſible, and that ſhe might always boaſt that he belonged to her, thought fit to continue

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to him the Title of Professor in her University, with the same Allowance as before.

Venice would not suffer him to remain long in the peaceful Exercises and Shade of an University. In 1700, she sent him into *Dalmatia*, to repair the Ruins of *Castelnovo*, and some time after into the Country of *Friuli*, where a most impetuous Torrent, that had already destroyed several Villages, was going to fall upon the important Fortrefs of *Palma*. Mons. *Guglielmini* discovers so much love for the Publick Welfare in all his Works, even in those where the dry Mathematicks predominate, that all these Voyages, and all these Fatigues, may be reckoned by us among the pleasant Parts of his Life.

Perhaps the Zeal he had of being useful to the Publick all manner of ways, made him return again to Physick, which he seemed before to have sacrificed to the Mathematicks. In 1702, he took the Chair of Professor of Theoretical Physick at *Padoua*, and left that which he had before. A Dissertation that he had published the foregoing Year, *De Sanguinis naturâ & constitutione*, might have been esteemed a Presage of this Change; at least was it a Proof both of his great Labour, and of the great Extent of his Learning.

But he gave a much more shining one, by his Book, entitled, *De Salibus Dissertatio Epistolaris Physica Medico-Mechanica*, Printed at *Venice* in 1705. It is not a long time ago that all the Treatises upon Chymistry were accounted no more than so many sorts of Poetical Fictions, lively, animated, and agreeable to the Imagination, but unintelligible and unsupportable by Reason. Sound Philosophy

osophy coming upon the Stage, has undertook to reduce to plain Corpusculary Mechanicks, that Chymistry so mysterious, and in some Sense so proud of its own Obscurity. However it must be confessed, that there still remain with some Authors, Traces of its ancient Poetry, Unions almost Voluntary, Combats only founded upon certain Disagreements, and some other Notions that are by no means consistent with the rigid Mechanicks. Monsieur *Guglielmini* seems to have stood extreamly upon his Guard to prevent these Whimsies from creeping into his Chymical Dissertation; he there reduces every thing with Severity to the Rules of exact and clear Physicks; and that he may yet more perfectly purge his Chymistry, and carry of all its Filth, he mixes it with Geometry. The Ground of the whole Work is, that the first Principles of Common *Salt*, *Vitriol*, *Allum*, & *Nitre*, consist, from their original Creation, of fixed and unalterable Principles, and are indivisible with respect to the determinate Force or Strength that is in Matter; the Primitive Figure of the Common Salt is a little *Cube*, Salt of Vitrol a *Rhomboid Parallelepipedon*, Nitre a *Prism*, whose Basis is an *Equilateral Triangle*, and Allum a *Quadrangular Pyramid*. From these first Figures proceed those which they constantly affect in their Crystalizations, provided they are kept as free as possible from all Foreign Mixtures.

In treating about the Action of Salts, *Monf. Guglielmini* examines Geometrically and Mechanically the Properties of these Figures, with respect to Motion, and comes to a Detail of them, curious enough

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enough and very new, in a Discourse of Chymistry.

He does not relate either the Experiments or new Observations he has made ; he establishes his System upon those of the most famous Authors, among whom he often quotes in the Academy, Messieurs *Homberg*, *Lemery*, *Bouldue*, and *Geoffroy*; in a word, 'tis not so much Chymistry as Geometry that prevails in this Treatise, and which is yet more valuable, the very Spirit of Geometry.

When the Impression of this Book was finished, the History of the Academy for the Year 1702, fell into his Hands. He there met with an Opinion of *Monf. Homberg* quite different from his own, *viz.* That the constant Figures of Acid Salts in their Crystallizations do not proceed from the first Particles of which they are composed, but from *Alkali's* with which they are united. He confesses he was afraid that the Authority of so great a Chymist might have alone sufficed to overturn his whole System, and he made hast to secure it by an Answer, which by being very civil and obliging, loses nothing of its Strength, nay perhaps acquires more.

He composed two other Physical Works, one entitled, *Exercitatio de Idearum vitiis, correctione, & usu ad statuendam & inquirendam morborum naturam*, in 1707, and the other *De principio Sulphureo*, in 1710; and that which is very glorious for him is, that the Date of the latter Work is the same with that of his Death. His whole Life was devoted to the Sciences, which those who love with less Zeal than he, may reproach him for as an Excess; and indeed it was such an Excess as destroyed
a very

The Life of Monsieur CARRÉE. 181

a very robust Constitution, and yet it must not be condemned but with Respect. He had that outward Appearance which is usually the result of Lives spent in a Closet, something a little uncouth and wild, at least to such as were not accustomed to him; *he despised as the Journal des Sçavans of Italy informs us, that Superficial Politeness with which the World is satisfied, but he had formed to himself one of another kind that resided altogether in his Heart.*

His Place of *Foreign Associate* in the Academy was filled by the Earl of Pembroke.

The LIFE of Monsieur CARRÉE.

Lewis Carrée was born the 26th of July 1663. He was the Son of an honest Farmer of *Clofontaine* near *Nanguis* in the County of *Brie*; his Father designed to make a Priest of him, but he did not feel in himself any Call to that Holy Office. However, out of Obedience to his Parents, he studied Divinity three Years, at the end of which, as he continued to decline taking Orders, his Father refused to contribute any longer towards his Subsistence at *Paris*. 'Tis very common for Men to embrace that kind of Life to preserve themselves from want, but he chose rather to fall into want than to become a Clergy-Man; by the Sequel of his Life, we shall find that the extream Aversion he had to that State was only founded upon the great sense he had of his being unequal to the Duties of it; *The Cause that*

that kept him from it, render'd him more worthy of it.

His evil Fortune became a great Advantage to him; he sought out for an Asylum, and found one with the Reverend Father *Malbranche*, who made him his Amanuensis. From the dark Scholastick Philosophy, he was thus at once transplanted to the Spring of a bright and shining Philosophy, in which he saw a total change of every thing, and a new World was discover'd to him. Under this Great Master he learned the Mathematicks, and the most sublime Metaphysicks, and at the same time conceived a very tender Affection for him, which alone is a sufficient Commendation both of the Master and Scholar. Monsieur *Carée* did so well divest himself of the common Prejudices, and so greedily imbibed those new Principles his Master taught him, that he seemed no longer to see with his own Eyes, but by *Reason* only, which usurped in him the Place, and all the Authority of his Senses. For instance, he did not believe that Beasts were meer Machines in the same manner as one may believe it by the strength of reasoning, and by the Principles of a System that leads to it; but he believed it as one commonly believes the contrary, because one sees or fancies that one sees it; the Artificial Conviction of Philosophy, tho' slowly formed by long windings and turnings was equal in him to the most natural Conviction, and such as might have been caused by the quickest and liveliest Impressions. *What he believed, that he saw; whereas others believe, because they see.*

However,

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However, it is infinitely more easie to become the Slave of certain speculative Opinions, very opposite in appearance, than to be sincerely and tranquilly Masters of our Passions. Monsieur *Carrée*, who did not forsake his old Principles by halves, was come thus far, and was so much the more obliged to come thither, as the System which he had embraced with so much Zeal, was a perpetual Union of Philosophy and Christianity. His Metaphysicks made him despise the *occasional Causes* of Pleasures, and united him to their ownly efficacious Cause; the love of Order establish'd Justice in the bottom of his Heart, and render'd all his Duties Pleasures; in a word, Philosophy was not in him a light Tincture, nor a superficial Ornament, but became a profound Sentiment, and a second Nature, very hard to be distinguish'd from the first.

After having been seven Years in that excellent School, where he learned all that we have mentioned, the necessity of looking out for some kind of Employment, in order to his Subsistence, obliged him to leave it, and to go into the City to teach the Mathematicks, and Philosophy, and especially that kind of Philosophy of which he was so full: The relation it has to Morality, and to the true Happiness of Man, made it become infinitely more valuable to him than all the Geometry in the World. He even endeavour'd to proceed in such a manner, as that Geometry should only be a step to guide him to his dear Metaphysicks, which he had always in view, and his greatest Pleasure was continually to procure new Votaries to it. His Zeal and Cares met with all the Success he desired; he
convinced

convinced all whom he undertook, unless it were such Philosophers as had been harden'd in other Systems.

I know not by what particular Fate it was that he reckon'd a great many Women among his Disciples. The first of those whom he had converted; soon discover'd that Monsieur *Carrée* was guilty of several odd and improper ways of Speaking; whereupon she told him, that she would pay his new Philosophy by teaching him to speak true French, and he acknowledg'd that he had very much improved his Language by her Instructions. In general, he had a great Opinion of the Sense of Women, even with respect to Philosophy, whether it was that he found them more tractable, because they had not been prejudiced by any contrary Notions, and that they only endeavour'd to Learn, and not to Dispute; or whether he was better pleased with their zealous adherence to the Opinions they had embraced; or lastly, whether it was upon account of that general Inclination we have for that Sex which acted in him, without his perceiving it; and made them appear to him better Philosophers, that being the greatest Ornament they could have in his Eyes.

His Conversation with them did yet season the Mystery: *for Women are not less obliged to conceal the acquired Lights of the Mind than the natural Sentiments of the Heart; and their greatest Art ought always to be even scrupulously to observe the external Decencies of Ignorance.* He would therefore never make mention, or tell the Names of those Ladies whom he instructed; nay, he would not so much as visit them, but with such

Precautions as are used upon a very different Occasion. Besides the Women of the World, he counted among his Disciples several Nuns, yet more Docil, more Studious, and more easily embark'd in that which affects them.

In short, he found himself at the head of a little hidden Empire, but which would submit to nothing but *Reason*, nor obey any thing but *Demonstration*.

The Business of Teaching in the City, is not less an Enemy to Studies, than the Distractions occasioned by Pleasure. It is true, one may strengthen and confirm one self in what one knows already; but 'tis impossible to make new Acquists, especially if one has the Misfortune to be very much employed.

And accordingly Monsieur *Carrée* wanted very much of being as far advanced in the Mathematicks as he could go; he saw with wonder and with grief too, the sublime and rapid Flights of certain Geometricians of the first Order, whilst the Cares for his Subsistence forced him, in spite of his Inclinations, to creep upon the Ground. He followed them however as far as he could with his Eyes; he made the best use he could of his Time, to study thoroughly what he communicated to the Publick; he enriched himself with their Discoveries, and if he was concerned that he himself could not make as shining ones, he did much less regret the Glory than the Knowledge which they produced.

Monsieur *Varignon*, who has been always very careful in the choice of those Pupils which he made in the Academy, took him for his, in the Year 1697. Mons. *Carrée* thought himself obliged to convince the Publick that he deserved the Title of Academist,
and

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and having therefore surmounted his Natural Aversion of appearing in Print, he put out the first Body of a Work, that has appeared upon the *Integral Calculation*; the Title of it is, *A Method for the Measure of the Surfaces, the Demension of Solids, their Centres of Gravity, of Precussion, and of Oscillation. In the Year 1700.* The Preface of this Book declares it to be only for the most plain and easie Application of the Integral Calculation; it sets it at a just Price, and is neither Boasting nor Modest; but, which is more valuable than Modesty it self, exactly true. The Author afterwards acknowledges some Faults, and had the Glory of correcting 'em in a Second Edition.

The Fate of Monsieur *Varignon's* Pupils is to make their way readily enough in the Academy, the reason of which has been already given. *Monf. Carrée* became in a little time *Associate*, and at last *Pensioner*; an Establishment sufficient to such moderate Desires as his, and which enabled him to give himself up entirely to his Studies. As he had the Office of a Mechanist, he turned his chief Thoughts that way, and applied himself to every thing belonging to Musick, such as the Theory of Sounds, the Description of different Instruments, &c. He did not embrace that Study on the Account of its being the spring of one of the greatest Pleasures of Sense, but as it required an Infinity of crabbed and thorny Discoveries: Our History of the Academy has given some Sketches of his Meditations upon this Subject.

His Labours were very much interrupted by a continual Indisposition into which he fell, and which grew upon him during the last five or six Years
of

of his Life ; his Stomach did very ill perform its Functions, and his Physicians observed from the Nature of his Distemper, that very corrosive Acids which were predominant in his Constitution did entirely destroy it. Being almost incapable of Studying, and yet more so of any profitable Employment, he found a Retreat with *Monf. Chauvin*, one of the Counsellors of Parliament, who was no otherwise incommoded by his Guest, than from the Difficulty he had of making him receive such Assistance as was necessary to him.

After a long Alternative of Relapses and Intervals of a very weak Health, he fell at last into a Condition in which he was the first that pronounced Judgment against himself. He told the Priest, who according to the usual Custom was seeking Expedients to prepare him for Death, *That Philosophy and Religion had long since taught him the Art of Dying.* Indeed he met Death with all that Constancy that both Philosophy and Religion are capable of giving. He reckon'd up with great Tranquility how many Days he had yet to live ; and when upon the last Day, how many Hours ; for that *Reason*, which he had so much cultivated, was revered even by the Distemper it self. Two Hours before his Death, he caused to be burnt in his presence several Letters that he had received from Women. It is easie to guess at the Subject of those Letters, and that his Discretion was very different from that which is shewn in the like Case by many other People of another make than he was. He died the 11th of *April*, 1711. I shall only add a few strokes to what I have already said upon the Character of the Man.

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He never asked twice what was his Due for the Pains he had taken. People were free to use him as ill as they would in that respect; and moreover they were sure of its being a Secret. He loved the Academy as his second Country, and would have done for its sake the Exploits of a Roman. It is true, I can give no other Instances of it than the Discourses that he and I have had upon certain Occasions, but those Discourses were strictly sincere, and proved as much as the Actions of another Man. I knew likewise that in one of those Fits in which he thought he should have died, he endeavour'd to put off that Panegyric Account of him which I am obliged to give of all those Academists we have the Misfortune to lose: His Modesty must have been very great, to fear so plain and honest a Discourse, and in which so little Eloquence is used by us. He left the Academy several Treatises composed by him upon different Subjects of Physicks or Mathematicks, and thereby made her his universal Heir.

His Place of Pensionary Mechanist was filled by Monsieur de Reaumur.



The LIFE of Monsieur BOURDELIN.

A **C** **V** **V** *Laude Bourdelin* was born the 20th of June, 1667. He was the Son of *Claude Bourdelin*, Pensionary Chymist of the Academy, of whose Life we have given some Account in our History for the Year 1699. He was brought up with great care in his Father's House: The late *Monf. du Hamel*, Secretary of the Academy, chose him all his Masters, and watched over his Education. At the Age of 16 or 17 Years he had Translated all *Pindar* and *Lycophron*, the most difficult of the *Greek Poets*; and on the other hand, he had made himself Master, without any help, of the great Work of *Monf. de la Hire* upon the *Conic Sections*, more crabbed, for the *Matter* of 'em, than the above-mentioned Poets are for their *Stile*. 'Tis a great Journey from the *Greek Poets* to the *Conic Sections*.

The Variety of his Learning put it into his Power to chuse what Employment he would, but his Natural Inclination determined him to Physick, in which he had already received great assistance at home. He was born in the midst of the whole *Materia Medica*, in the Bosom of Botany and Chymistry; He therefore applied himself with vigour to the necessary Studies, and was received Doctor in Physick of the Faculty at *Paris*, in 1692.

In this Profession he loved both the Knowledge it required, for which he had a very happy disposition;

sition; and yet more beyond Comparison, the Advantage it would bring to Mankind. This Advantage, which ought always to be the principal Object of the Physician, as well as of Physick it self, was the sole aim of *Monf. Bourdelin*. It is true that he was born to a very good Fortune, and might have lived at his Ease, tho' all the World had continued in good Health, but his Dis-interest-*edness* did not proceed from his Fortune; it was the result of his Character, for it is no strange thing for a rich Man to desire to be richer. *Monsieur Bourdelin's* Patients were unprofitable enough to him, excepting the Satisfaction he had in assisting them, for *his Care was to visit as many of the Poor as he could, and he visited them preferably to others; he paid for their Medicines, and even provided often for them such other Helps as they stood in need of; and as for the rich People, he studiously avoided to receive from them what was his Due; he was plainly uneasie when he received his Fees; and without doubt the greatest part of such Patients readily spared his Modesty, or accommodated themselves to his Generosity.*

As soon as the Peace of *Ryswick* was concluded, he laid hold of it to see the Learned Men of *England*; the Reward of his Journey was a Place in the *Royal Society*, he did not seek for it, and it was therefore so much the more his due.

He was not less favourably treated in his own Country. The Academy of Sciences, which had a Right to him by many Titles, chose him for one of their *Associate Anatomists*, upon their new Establishment in 1699. He was a great Master, not so much of Anatomy it self, as of its History, or
of

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of Anatomical Learning. In our History for the Year 1700, it may be seen, that upon a very difficult Question, which divided the Anatomists of the Academy, and in which there was some Matters of Fact and Difficulties upon the Choice of the necessary Operations, they had recourse to Monsieur *Bourdelin*, and that he laboured very advantageously in the Preliminaries towards the Explanations thereof.

In 1703, he bought the Office of Physician in Ordinary to the Dutchess of *Burgundy*. We are assured that one of his Principal Motives was, the Desire he had to bestow upon the Publick his Pains entirely free from Interest, and to deliver himself from those uneasy Acknowledgments which he could not altogether avoid in *Paris*. We should not have advanced a Fact so very unlikely, if his whole Conduct had not proved the same. Before he removed to *Versailles*, he spent four or five Months in refreshing his Botany with Monsieur *Marchant* his Friend and Colleague. He foresaw very well that he should not have much time to go a Simpling in his new Habitation: He was resolved therefore to fortify himself before-hand with all the Lights necessary to that purpose. When he left the Town it was a general Affliction and Mourning among all the Poor in his Neighbourhood. *The greatest Qualities of Men, are those of which the common People are the best Judges.*

He lived at *Versailles*, as he had done at *Paris*, as diligent without any private Interest, as indefatigable, or at least as prodigal of his Pains, as any Physician in the World that was in the greatest

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need, and had the greatest desire of heaping up Riches. His love of the Poor was always his predominant Passion. When he returned home from visiting a great many poor Wretches in their Beds, he always found a Troop waiting for him at his Doors. It is reported, that one day as he passed along the Streets in *Versailles*, some of the common People cried after him, '*Tis not our Physician, but our Saviour* ; an Exaggeration foolish in it self, but in some manner excusable, because it shewed the Gratitude as much as the Ignorance of those poor Creatures.

It is particular enough, that in a Place where all Professions, be they what they will, are turned into that of Courtier, he continued a Physician still, and did no more than his Business at the hazard of not making his Court ; but his great Reputation made it for him, for *Monf. Bourdelot*, first Physician to the Dutchess of *Burgundy*, dying in 1708, that Princess, of her own accord, recommended *Monsieur Bourdelin* to the King for so considerable a Place, and immediately obtained his Consent. She had the Glory and Satisfaction of rewarding Merit that did not seek it ; the Courtiers knew of his Advancement before himself, and he was only informed of it by the Compliments they paid him.

His Manners were not changed, nor shaken by his new Dignity, he was always the same, only he was more Bountiful to the Poor, because his Abilities were increased. However, his continual Fatigues very much weaken'd his Health. A troublesome and dangerous Cough suffer'd him to take no rest. Whether it was an Indifference for Life,

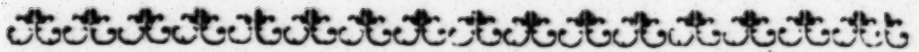
or

or whether it was a certain Intemperance, and Excess of good Works, a Fault that is not very common, he is charged with not taking so much care of himself as he always took of others. *He drank Coffee to keep himself from sleeping, that he might work the more, and then took Opium to recover his Sleep.* Above all, it was the immoderate use of Coffee that he was the most blamed for; he made himself believe a long time that he was irrecoverable, to the end that he might drink as much as he would of it. At last after having fallen by degrees into a great Extenuation or Leanness, he died of a Dropsie in the Stomach the 20th of *April, 1711.* His last words were, *In te Domine speravi, non Confundar----*He could not finish the two Words that remained. *Such a Life as his was Worthy to end with such great Tokens of Faith.*

He left four Children by a most virtuous Wife, with whom he always lived in the greatest Friendship and Affection. We shall not stay to relate how zealous and officious he was for all his Friends, how kind and good to his Domesticks; it is better to leave you to guess at the natural Consequences of the Character in which we have represented him, than to be suspected of Partiality, in loading him with too many Perfections.

His Place of *Associate Botanist*, to which he had been preferr'd from that of *Anatomist*, was supplied by *Monf. Geoffroy, the Younger.*





The LIFE of Monsieur BERGER.

Claudius Berger, the Son of Claudius Berger, Doctor of Physick of the Faculty of Paris, was Born on the 20th of Jan. 1679. He had devoted himself to his Father's Profession, and whilst he was a Student of the Faculty he maintained a Thesis, Mr. Fagon, the King's first Physician, presiding, against the Use of Tobacco; the Style and Learning of which were generally admired, but the Precepts very little followed.

Tho' Mons. Berger was related to Mons. Fagon, and pretty nearly too, 'twas upon the occasion of this Thesis that he came to be more particularly known than he had been before, and was received into a Friendship and Patronage, which their Kindred alone could not have obtained for him.

Mons. Berger applied himself a great while to the Study of Plants under Mons. Tournefort, in which he made such a Proficiency that this great Botanist procured him to be admitted as his Pupil into the Academy of Sciences, upon its Re-establishment in the Year 1699. Since when, upon certain Dispositions made in that Society, he became the Pupil of Mons. Homberg. He appeared equally fit to fill one day the chiefest Places either in Botany or Chymistry.

But different Employments diverted him from those Functions that are required by the Academy; having taken his Degree of Doctor of Physick, he was

was obliged to profess a Course of it in the Schools of *Paris* for the Space of two Years, which he did with great Success. Besides, his Father who was a good Physician, and had a great deal of Practice, took him often with him to his Patients, and instructed him in his Business, both by his own Example, and by the Observation of Nature her self, a more efficacious and lively Lesson than all those that are taken out of Books; and as his Father, by reason of his Indispositions, was confined to his House the two last Years of his Life, he discharged his Function by the means of his Son, to whom he gave his Prescriptions as well as his Learning; and accordingly after his Death, which happen'd in 1705, the Son succeeded to all that Trust and Confidence which had been put in his Father, and found himself possessed of all his Patients, as it were by Inheritance. At last *Monf. Fagon*, who was Professor in Chymistry to the Royal Gardens, but could no longer follow that Business, made *Monf. Berger* his Deputy in the Year 1709; and after he had been so the two following Years, *Monf. Fagon* was perswaded that he acquitted himself so well therein, that he obtained of his Majesty the Survivorship for him, a Favour which he would not have easily asked for a Person that was but indifferently qualified for it, because we know that he had always been very jealous of the Honour of that Place.

All these things, tho' they hinder'd *Monf. Berger* from the punctual Discharge of his Duty to the Academy, did nevertheless qualify him to become a great Academist; and it is very probable the Society would have been the better, even for those
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his Avocations and Employments that did not immediately concern them; but his tender Constitution could not bear up against the great Business he was engaged in, and his Lungs being attacked, he died the 22d of *May*, 1712. Monsieur *de la Carliere*, the Duke of *Berry's* first Physician, and very noted in his Profession, had designed him for his only Daughter, and all the Circumstances of that kind of Adoption are still part of *Monf. Berger's* Character. His Place of *Pupil* to *Monf. Homberg* was filled by *Monf. Imbert*, Doctor of Physick.



The LIFE of Monsieur CASSINI.

 *Obn Dominic Cassini* was born at *Perinaldo* in the County of *Nice*, the 8th of *June* 1625. His Father was *James Cassini*, an *Italian Gentleman*, and his Mother's Name was *Julia Crovesi*. As soon as he was out of his Childhood, he was put under the Care of a very able Tutor, with whom he made his first Studies: He continued 'em in the College of *Jesuits* at *Genoa*, where some of the *Latin Poems* of this Scholar were printed with those of his Masters, in a Folio Collection, in the Year 1646.

He contracted a very intimate Friendship with *Monf. Lescaro*, who was afterwards *Doge* of that Republick. He was with him at one of his Seats when a Clergyman put into his Hands some Books about *Judiciary Astrology*. His Curiosity was stirred up by them, and he made an Extract for his own Use; that natural Instinct which led him to the Knowledge

Knowledge of the Stars, made him then mistake *Astrology* for *Astronomy*, in the Study of which he advanced so far as to make some attempts at Predictions, and not without Success; but even that which would have plunged another into perpetual Errors made him suspect it. He discover'd by the integrity of his Mind, that this Art of foretelling was merely Chimerical, and he feared, such was the Delicacy of his Conscience, that Success was the Punishment of those that applied themselves thereto. He carefully perused the fine Work of *Pica de la Mirandula* against *Astrologers*, and then burnt the Extract he made from their Books. But whilst he was amusing himself with the trifling and ridiculous Study of *Astrology*, he discover'd the solid Charms of *Astronomy*, and was sensibly affected with them.

Tho' Astronomy were not so absolutely necessary as it is in Geography, in Navigation, and even in Divine Worship, it would be infinitely worthy of the Curiosity of all Humane Minds, on account of that great and lofty Spectacle it presents to their View. There are in certain very deep Mines some miserable Wretches that both live and die without ever seeing the Sun; such is in a manner the Condition of those that are ignorant of the Nature, Order and Motion of those great Globes that roll over their Heads, to whom the greatest Beauties of Heaven are unknown, and who have not Sense enough to enjoy the Universe. This is the Business of *Astronomers*, they both give us Eyes, and unvail to us the vast Magnificence of a World that is inhabited by almost none but Blind Men.

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Monf. *Cassini* applied himself zealously to Astronomy and the Preliminary Sciences, in which he made so swift a Progress, that in 1650, that is to say, when he was but 25 Years old, he was chosen by the Senate of *Bologna*, to fill the first Chair of Astronomy in their University, which had been vacant some Years by the Death of Monsieur *Cavalieri*, the famous Author of the *Geometry of the Indivisibles*, and forerunner of the *Infinitely Littles*, to whom they had not yet been able to find a worthy Successor. Upon his Arrival at *Bologna*, the Marq. *Cornelio Malvasia*, who had very much contributed to the inviting him, received him into his House. That Marquis was one of the Senators of his Country, General of the Troops of the Duke of *Modena*, and a learned Man. Three Qualities which he joined together, after the Example of the ancient *Romans*, but so uncommon in this Age, as to be accounted almost fabulous.

At the end of the Year 1652, a *Comet* came to try the Skill of our new Professor of Astronomy, and to offer it self to him as one of the greatest Difficulties of his Trade. He observed it with Mr. *Malvasia*, who was also an Astronomer; it passed by their *Zenith*, an uncommon Circumstance. Monf. *Cassini* made all the Enquiries upon this Phenomenon that Art could desire, and all the Determinations he could furnish, and in 1653, published a Treatise upon it, which he Dedicated to the Duke of *Modena*.

In that Work he takes *Comets* to be nothing but fortuitous Generations, and a mass of Exhalations proceeding from the Earth and from the Stars too; but he soon formed a more particular and noble Idea

Idea of them ; He perceived that the Motion of his Comet might be unequal in appearance only, and that it was reducible to as great an Equality as that of a Planet ; and from thence he conjectured that all the Comets, which had always passed for new Stars, and were thought to be entirely exempt from the Laws of all the rest, might be both of the same Regularity and of the same Antiquity too as those Planets to which we have been accustomed from the beginning of the World. *In all matters, the first Systems are too short, too narrow, and too diffident, and it seems as if Truth it self were only to be the Prize of a certain Boldness of Reason.*

It was this happy and wise Boldness which made him undertake the Resolution of a Problem which was fundamental for all Astronomy, which had been attempted several times by the most able Mathematicians, but without Success, and even declared impossible by the famous *Kepler*, and by *Monf. Bouillaud*, a great French Astronomer, viz. *Two Intervals between the true Place, and the middle Place of a Planet being given ; it was required to determine Geometrically the Apogaeum and Excentricity thereof ?* *Monf. Cassini* performed it, and very much surprized the learned World. His Problem began to open to him a Way to a new and more exact Astronomy ; but as he stood in need of a great number of Observations to render his own Invention useful, and which he had not yet the time to make (having hardly attained to the Age of 26 Years) he writ to *Monf. Gassendi* in France, desiring him to communicate those that he might have made, chiefly upon the
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Superiour Planets; he obtained them without difficulty from a Man that was both zealous for the Sciences, and favourable to the Reputation of those that cultivated them.

But there remained yet at the bottom of Astronomy several important Doubts and essential Difficulties. It is certain both that the Sun appears to move more slowly in Summer than in Winter, and likewise that it is more remote from the Earth in Summer; this greater Distance ought to lessen the appearance of its Swiftnes; but is there not moreover a real diminution in that Swiftnes?

It is the Sentiment of *Kepler* and *Bouillaud*; all the rest, both Ancient and Modern, believe the contrary; and the Certainty of the Theory of the Sun and of the other Planets depended in a great measure upon this Question; to decide which, it was necessary to observe whether when the Sun was most remote from the Earth, the diminution of its Diameter, for it ought then to appear lesser, did exactly follow the same Proportion as the diminution of its Swiftnes; in this Case most certainly all the diminution of Swiftnes was only apparent, but the difficulty was to make those Observations with sufficient Certainty; but as the Question was only about a Minute, more or less, in the greatness of the Sun's Diameter, and the Instruments were too small to give it with Certainty, every Observer might either add or take it away at his pleasure, and dispose of it in favour of his Hypothesis, and so the Question would always remain undetermined. We shall give no more than this instance of the extream Importance that even the smallest Quantities may be with respect to Astronomy; tho' in all other Cases they

they are hardly worth notice. In general, it is easie to conceive that when we make use of a Quadrant for Observations, the proportion it bears to the Greatness, which it is to measure, is almost infinitely little, since the thickness of a Silken Thread answers two Millions of Leagues in the Heavens; thus the nicety and exactness of Astronomy requires large Instruments.

An Occasion happily offer'd it self to Monsieur *Cassini* to procure the largest that ever was made, just at the time when he was upon new modelling this Science. The Confusion into which the *Julian Calender* was fallen, by the neglect of some Minutes yearly, awaken'd the Astronomers of the 16th Century; they would find by Observation the *Equinoxes* and *Solstices*, which the Calender did not give within ten Days at least of the true time; and for that purpose *Egnazio Dante*, a Dominican Fryer, and Professor of Astronomy at *Bologna*, in the Year 1575, drew in the Church of *St. Petronia*, a Line, which shew'd the Sun's way during the whole Year, and chiefly its arrival at the *Solstices*. In the Year 1653, that Church was enlarged, which put *Monf. Cassini* upon a design of drawing, in another Part of the Church, a Line that should be longer and more exact and useful than that of *Dante*, which was not even a *Meridian*. As it was necessary that the Line should be perfectly streight, and that by its Position it was obliged to pass between two Pillars, it was thought at first it could not pass, and must be lost against one or the other.

The Magistrates, who had the Care of Building, scrupled giving their Consent to so doubtful a Project. *Monf. Cassini*, by a Treatise which he published,

published, convinced them that it was practicable. He had taken his Measures so nicely, that the *Meridian* passed by the Sides of those two dangerous Pillars, that had like to have made his whole Design miscarry.

A round Hole horizontal, an Inch in diameter, bored through the Ceiling, and of a perpendicular Heighth of a thousand Inches over a Marble Pavement, upon which the Meridan was traced, receives every Day, and sends to the South upon that Line, the Image of the Sun, which there becomes Oval, and moves upon it from Day to Day, according as the Sun approaches or recedes from the Zenith of *Bologna*. When the Sun is as near it as it can be, one Minute of variation in its Heighth, is answer'd by four Lines of a Foot (*Paris* measure) upon the Meridian, and when the Sun is farthest off, two Inches and one Line; so that this Instrument is of an Exactness beyond what could have been expected; it was made with a Care and Application that was almost superstitious. Father *Riccioli*, a good Judge of these Matters, says, it was more Angelical than Humane; the Particularities of it would be infinite. *In the Mathematical Sciences, Practice is a Slave, and Theory its Queen*, but here the Queen is absolutely depending upon the Slave.

This great Work being finished, or at least sufficiently advanced, *Monf. Cassini* publicly exhorted all the Mathematicians to observe the Summer *Solstice* of the Year 1655. He said, in that Poetical Stile, which the dry Study of the Mathematicks had not deprived him of, that he had set up an Oracle of Apollo of the Sun in a Temple, which might be confidently consulted upon all the Difficulties

ficulties of Astronomy. One of the first Answers this Oracle render'd was, upon the Variation of the Sun's Swiftneſs; he declared poſitively in favour of *Kepler* and *Bouillaud*, that it was partly real; and thoſe whom he condemned ſubmitted themſelves. Monſ. *Caffini* printed that ſame Year a Treatiſe upon the Uſe of his Meridian, and Dedicated it to Queen *Chriſtina* of *Sweden*, who was lately arrived in *Italy*, and upon the account of her Taſt for the Sciences was worthy ſuch an Entertainment.

The New Obſervations of Monſ. *Caffini* were ſo exact and deciſive, that from them he compoſed Tables of the Sun, more certain than thoſe that had been hitherto published. It might have been objected againſt him, that his Meridian was a great help, which other Aſtronomers wanted; but then that aſſiſtance was wholly owing to himſelf.

Nevertheless his Tables had ſtill one defect which his Oracle did not fail to take notice of. *Tycho Brahe* firſt diſcovered that the *Refractions* increaſed the apparent Heighth of the Stars above the Horizon, but his Opinion was, that thoſe *Refractions* did not extend farther than to the 45th Degree, after which they entirely ceaſed. Monſ. *Caffini* followed the ſame, but after many Trials and Geometrical Examinations of the Nature of *Refraction*, which till then had not been known, but by Obſervations always liable to ſome miſtake, he found that they reached even up to the *Zenith*, tho' from the 45th Degree quite to the *Zenith* there was but one Minute to be divided among the 45 Degrees that remained; another ſeeming Trifle in Astronomy, but of the utmoſt Conſequence. It is the Fate
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of Novelties (of those even that are the best proved) to be contradicted. Among those that oppose them, we count for nothing a Drawer of Horoscopes, who writ against his System of Refractions, and objected that he was not yet old enough to know them. Father *Riccioli* himself did at first scruple to submit to it, but *Monf. Cassini* cited him before *St. Petronia*, where he was very strong.

He made use of his new Theory of Refractions to compose second Tables more exact than the former; he joyned thereto the Parallax of the Sun, which he believed, tho' with some doubting as yet, could not be above ten Seconds, and thereby he removed the Sun from the Earth six times farther than *Kepler* had done, and eighteen times more than some others. The *Marq. Malvasia* calculated *Ephimerides* for five Years, beginning at 1661. *Monf. Gemignano Montanari*, Professor of the Mathematics at *Bologna*, declared in Print, that when they computed by those *Ephimerides*, the Instant in which the Sun should arrive at a determinate Point of the Meridian of *St. Petronia*, it never failed to happen accordingly. *Lansberg* has been formerly convinced of falsifying his Observations to make them agree with his Tables; so much did the Astronomers flatter themselves with attaining to that Agreement, and the rest of Mankind, with enjoying the Opinion of others, even where there was no foundation for it.

But *Monsieur Cassini* was interrupted in his Astronomical Employments, and forced to come down from the Region of the Stars, to apply himself to Affairs that were meerly Terrestrial; the frequent Inundations of the River *Po*, its uncertain and irregular Course,

Courſe, the Diviſion of its Branches ſubject to changing, even the Remedies themſelves applied to this Evil (which ſometimes did nothing but increaſe, or remove it from one Country to another) all this I ſay, had been an old and fruitful Spring of Differences between the little Governments bordering upon the ſaid River, and chiefly between *Bologna* and *Ferrara*. Thoſe two Cities, tho' both ſubject to the Pope, are diſtinct Governments, and both of 'em have preſerved the Rights of ſending Ambaſſadors to their Sovereign. As the People of *Bologna* had a great many things to regulate with thoſe of *Ferrara*, upon the occaſion of the Waters, they ſent the Marquis *Tanara* Ambaſſador Extraordinary to Pope *Alexander VII.* in the Year 1657, and order'd *Monſ. Caſſini* to accompany him in an Affair in which the Mathematicks had ſo great a part, perhapſtoo they were glad of that occaſion to ſhew the *Romans* the Acquiſition they had made of ſo learned a Man.

Being at *Rome* he publiſhed ſeveral Diſcourſes upon the Buſineſs that carried him thither; he went into the Detail of the whole Hiſtory of the *Po*, which he extracted both from Ancient and Modern Books, and from all the Monuments that remained thereof; for his profound Study of the Mathematicks had not excluded that of other kinds of Learning. He made, in the Preſence of the Committee of Cardinals appointed for the Waters, a great many Experiments relating to that matter, and which ſerved to ſupport the Pretenſions of thoſe who had deputed him; and he made appear the ſame Care and the ſame Exactneſs, that he was thought only capable of, in reſpect to the Heavens;

accordingly the Senate of *Bologna* were of Opinion, that they could not sufficiently reward his Services, but by conferring upon him the Office of Superintendant of the Publick Waters, an Employment of which we have before given an account in the Life of *Monf. Guglielmini*. They joyned him in Business with several Cardinals, to shew, that tho' he was a great Mathematician, he was as well qualified for worldly Affairs as other Men.

In the Year 1663, *Don Mario Chigi*, Brother to *Alexander* the VII. and General of the Holy Church, gave him the Direction of the Fortifications of *Fort Urbano*, of which he never dreamt: He found himself then transferred at once to the Military Services, and applied himself to repair the old Works of that Place, and to make new ones; but in the midst of those Occupations, he always bestowed some Contemplations upon the Stars.

Mention has been already made in the Life of *Monf. Viviani*, of the Dispute that happened between the abovementioned Pope and the Great Duke of *Tuscany* about the Waters of *Chiana*, and of the share *Monf. Cassini* had in that Business. The Pope, who had demanded him of the Senate of *Bologna* for that purpose, order'd the Cardinal *Rospigliosi*, afterwards *Clement IX.* to acquaint them that he had conceived a particular Esteem for *Monf. Cassini*, and intended to take him into his Service, without prejudice to his Establishment at *Bologna*; and indeed that Pope called him often to him to hear him Discourse upon the Sciences, and promised him great Preferments if he would take upon him the Ecclesiastical Function, for which he looked upon him to be very well qualified, by the integrity

integrity and purity of his Manners. The Temptation was strong, for in *Italy* a learned Clergyman may rise to such a Rank as hardly to give place to Kings themselves; there is no other Condition in that Country capable of such great Rewards; but *Monf. Cassini* did not find himself called to it, and *the same Piety which rendered him worthy of coming into the Church, kept him out of it.*

At the end of the Year 1664, there appeared a Comet, which he observed at *Rome* in the Palace of *Chigi*, in the Presence of the Queen of *Sweden*, who her self likewise made Observations, and sacrificed her Nights to that Curiosity. He depended so much upon his System of the Comets, that after the two first Observations, which were the Night between the 17th and 18th of *December*, and the following, he boldly marked out for the Queen upon the Celestial Globe, that Course which the said Comet was to take; when he had made his fourth Observation, which was upon the 22d, he affirmed, that it was not yet in its greatest Proximity to the Earth; upon the 23d, he foretold that it would arrive there the 29th, and tho' at that time it surpassed the Moon in Swiftness, and seemed as if it would have made the Tour of the Heavens in a little time, he had the Courage to assert that it would stop in *Aries*, from which it was not above two Signs distant, and that after it had been there Stationary, its Motion would then become Retrograde, in respect to the Direction it had had before; these Predictions met with a great many incredulous Persons, who maintained that the Comet would disappoint the Astronomer, and who wished it also even to the end; after which, when they found that it

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had perfectly submitted it self to his Laws, they, like the Comet it self, moved backwards, and said there was nothing more easie than what Monsieur *Cassini* had done.

There appeared a Second in the Month of *April* 1665 ; he presently made a Calculation or Table for it, which confirmed what he had done upon the preceding Comet ; some of those who did not believe him, set themselves to imitate him, but unfortunately ; they would likewise form Systems, and pretended that the new Comet was the same with the other, but the very Observations refuted them. As for him, about 8 or 10 Days after the first Appearance, he published his Table, in which the Comet was Calculated with the same Exactness as if it had been an old Planet ; he likewise published at *Rome* the same Year, a Latin Treatise upon *the Theory of these two Comets*, and Dedicated it to the Queen of *Sweden*, and some Italian Letters, which he inscribed to the Abbot *Octavio Falconieri*, in which he entirely discovered his Secret ; an Abridgment of which may be seen in the History of the Academy for the Years 1706, and 1708.

The Queen of *Sweden* having received from *France* an Ephemerides of the Motion of the first Comet made by Mons. *Auzout*, a most profound Mathematician and nice Observer, and having communicated it to Mons. *Cassini*, he discover'd therein, thro' some affected Disguisements, the very same Hypothesis that he had made use of with so great Success. He writ to the Queen, and the aforesaid Abbot about it, with a Satisfaction which one might easily perceive was sincere, and which chiefly consisted

sisted in observing that the Truth of his System was established by such a Conformity, nor was he at all troubled that another Man shared in the Glory of it. This System induced him to believe that the same Comets might appear again after a certain time; and we have likewise reported after him, in the Histories of 1699, 1702, and 1706, all the Arguments that might support that Notion, which has aggrandized the Universe and augmented its Pomp.

He was about this part of Astronomy (so new and so little handled) when the Pope sent him back to *Tuscany*, to treat along with the Ministers of the Great Duke upon the Business of the *Chiana*, and at the same time bestowed upon him the Superintendence of the Waters of the Ecclesiastical State; when he had discharged himself of those Commissions, he returned to his Pleasures, that is, to his Observations of the Heavens.

It was at *Città della Pieve* in *Tuscany*, the same Year 1665, (sufficiently memorable for Learned Events) that he discovered plainly, upon the Disk of *Jupiter*, the Shades which its *Satellites* cast upon it, as they passed between *Jupiter* and the *Sun*. His Business was to distinguish those Shades from the Spots of that Planet, some of which were fixed and others moveable; but those that were fixed, were only so for a time; and he did distinguish them so well, that it was by a fixed Spot well ascertained, that he found out that *Jupiter* turned round upon its Axis in the space of 9 Hours and 56 Minutes. The Learned disputed with him the Distinction between the *Shades* and the *Spots*, tho' he had demonstrated it Geometri-

trically, and had foretold both the Times of the going in or coming out of the Shades upon the apparent Disk of Jupiter, and those where the fixed Spot was to appear therein by the Revolution of the Globe. But it must be owned, that the extream subtilty of these Enquiries, and the very nice, and till then the new Use that was to be made of *Astronomy*, and of *Opticks* together, might be allowed to meet with Opposition from the Learned especially, who will not submit so readily as others to be instructed. *The Suspension of our Belief does honour to the finest Discoveries.*

Those of Monsieur *Cassini* were by so much the more important, that of all the Planets, 'tis Jupiter at present in whom we are most concerned. It is he that can decide the Question of the Mobility, or Immobility of the Earth; he shews to the Eye, and even more apparently than can be proved with us, all that *Copernicus* did only conjecture about the Earth, and that too with a kind of Rashness.

If we are surprized that so great a Body as that of the *Earth* should turn upon its own Axis, *Jupiter*, a thousand times bigger, moves two times and a half more swiftly; and if we think it strange that the *Moon* alone should have the *Earth* for the Centre of its Motion, *four Moons* or *Satellites* have *Jupiter* for the Centre of theirs.

When they could no longer deny the Truth of Mons. *Cassini's* Discoveries, they endeavoured to rob him of the Honour of them. In the Month of *Feb.* 1667, he laid hold upon a favourable Opportunity of observing *Mars* in his approaches to the Earth, and he judged by the Motion of some of its Spots, that that Planet turned upon its Axis in the space of

24 Hours and some Minutes. Those that observed it at *Rome*, to whom he had writ concerning it, had a mind to have prevented him, but he asserted his own Right very well, and proved that their Observations were both posteriour to his, and not so exact: He fixed the Revolution of *Mars* to 24 Hours 40 Minutes; a new Glory for *Copernicus*, whose System was corroborated in proportion as the Heavens disclosed themselves to the Eyes of *Monf. Cassini*. In the same Year he likewise discovered some *Spots* upon the Disk of *Venus*, and was of Opinion, that its Revolution might be pretty near equal to that of *Mars*; but as *Venus*, whose Orb is between the Sun and us, is liable to the same Variations of *Phases* as the *Moon*, and that by that Means the returns of its Spots are very hard to be discovered with certainty, he determined nothing positively, and his Caution upon doubtful Discoveries was a Confirmation of the Certainty of the rest.

In spite of the regard that ought to be paid to his useful Application to the Observations of the Heavens, the necessity of having Recourse to him did too often divert him from those Studies. Besides the Employments that he had already, and which were foreign to the Business of Astronomy, they put upon him the Inspection of the Fortifications of *Perugia*, and Repair of the Bridge called *Felix*, which the *Tiber* threatned to quit; he order'd a Work that prevented this Disorder. As he was possessed of a general Love for the Sciences, he would likewise abandon himself sometimes to voluntary Diversions.

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When he treated with *Monf. Viviani* upon the Affair of the *Cbiana*, he had made several Physical Observations upon *Insects*, which *Monf. Montalbani*, to whom he communicated them, caused to be published in the Works of *Aldrovandus*. Finally, the Experiments about the Transfusion of the Blood made in *England* and *France*, and which concerned none but the Physicians and Anatomists, being become very famous, he had the Curiosity to repeat them himself at *Bologna*; so eagerly did his Passion for Knowledge hurry him on to different Objects; for the same Reason, as he passed thorow *Florence*, in his Journies from *Bologna*, to *Rome*, the Great Duke and Prince *Leopold* caused Assemblies of their Academy *Del Cimento* to be held in his Presence, in the Opinion that he would communicate some of his Lights to them.

In the Year 1668, he published the Ephemerides of the Stars of the *Medicis*, for in *Italy* they are very jealous to retain that Name for the *Satellites* of *Jupiter*. *Galileo*, their first Discoverer, had in vain attempted to Calculate their Motions, and the Eclipses which they caused in *Jupiter*, by depriving him of the Sun, or which they themselves undergo by falling into his Shade; in effect it looks like an excessive and condemnable Boldness for Humane Minds to aspire to such Knowledges. All the Planets move in different Planes, which pass by the Centre of the Sun; that in which the Earth moves is the *Ecliptick*, the Orbit of *Jupiter* is another Plane inclined to the *Ecliptick* from a certain Number of Degrees, and cutting it in two opposite Points. This Inclination of the Orbit of *Jupiter* to the *Ecliptick*, and their common Intersections, tho' enquired into by the Astronomers of
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all Ages, and after a long sequel of Observations, are so hard to be determined, that different Astronomers disagree very much with one another about them, and sometimes even one and the same Astronomer cannot agree with himself. The reason is, because these Planes, tho' real, are invisible, and cannot be perceived but by the Mind, nor distinguished but by a great Number of very nice Argumentations. What shall we then think of Planes that are much more invisible, if one may so speak, in which the Satellites of *Jupiter* do move? It has been necessary to discover what Angles their Orbits make with that of *Jupiter*, and between themselves and with our *Ecliptick*, and besides what is the different greatness of those Angles as they are seen, or of the Sun, or of the Earth. In a word, in the Tables of these new Stars there enter 25 Elements, that is to say, 25 fundamental Knowledges or Determinations. It is not only therefore a great Effort of the Mind, to gather together and range so many Materials necessary to a Building, but likewise it is as great a one to know how many of those Materials are necessary, and not to forget any one of them.

As soon as *Monf. Cassini's* Tables appeared, all the Astronomers of *Europe*, who were warned by them of the Time of the Eclipses of the *Satellites*, observed them carefully; among the rest, *Monsieur Picard*, one of the Members of the new-born Academy of Sciences, and he found pretty often that they answer'd to the Heavens with greater exactness than the Author himself had promised; who reserved to himself a Power of rectifying them hereafter. *He had done that for four Foreign Moons*

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Moons vastly remote from us, and very lately known to us, which all the Astronomers of 24 Centuries had with much difficulty done for one Moon.

Monf. Colbert, who by the King's Directions had formed the Academy of Sciences in 1666, desired that Monf. *Cassini* might correspond with them; but the Passion that Minister had for the Glory of his Country, would not suffer him to be contented with a bare Correspondence, but induced him to invite him by Count *Graziani*, Secretary of State to the Duke of *Modena*, to come into *France*, where he should receive a Pension from the King equal to the Employments he had in *Italy*. He made answer, That he could not dispose of himself, nor accept of the Honour his Majesty was pleased to do him without the Approbation of the Pope, who was then *Clement* the IXth. Whereupon the King desired the Loan of him from his Holiness, and from the Senate of *Bologna* by the Abbot of *Bourlemont*, then Auditor of the *Rota*, only for some Years; they were afraid they could not obtain him without that Limitation, which probably was added for that purpose. They did him the Honour to believe that Artifice necessary, and condescended to make use of it.

He arrived at *Paris* in the Year 1669, being called from *Italy* by the King, as *Sosigenes* another famous Astronomer was invited from *Egypt* to *Rome* by *Julius Cæsar*. The King received him both as an uncommon Man, and as a Stranger that abandoned his Country for his sake. His Intentions were not to stay in *France*; and accordingly, at the end of some Years, both the Pope and the Govern-

Government of *Bologna*, who had continued his Salaries to him, earnestly desired him back again ; but *Monf. Colbert* did no less warmly dispute the matter with them, and had at last the Pleasure of conquering, and in the Year 1673, procured him to be Naturalized in *France*. The same Year he married *Geneveva* the Daughter of *Monf. Delaitre*, a Lieutenant-General. The King when he approved of his Marriage, had the Goodness to tell him, that he was glad to see him become a *Frenchman* for ever. Thus *France* extended her Conquests even into the Empire of Learning.

Monsieur Cassini having been a Foreigner, had reason equally to fear the partiality of the Publick, either in his Favour or to his Prejudice, and without a great Sock of Merit, he could not have saved himself from the Danger of either. He was sensible that he was going to begin a new Career, which was so much the more difficult, as that for the support of his Reputation he was obliged to surpass it. We shall not give the Detail of all that he did in *France*, but only hint at some of the most remarkable Passages.

The Academy having in the Year 1672, sent some Persons to make Observations in the Island of *Cayenne* near the *Equator*, because a Climate so different from ours was likely to furnish a number of Observations very different from those which are made here, and which might therefore be of great use to us, they confirmed all that *Monsieur Cassini* had laid down several Years before by Arguments and Theory about the *Parallax* of the *Sun*, and the *Refractions* ; so nice an Astronomer is almost a Prophet, and may pretend to the Glory of Astrological Predictions. More-

Moreover, one of the principal Designs of that Voyage to *Cayenne* was to observe the *Parallax* of *Mars*, at that time very near the Earth, whilst *Monf. Cassini*, and the rest of the Astronomers of the Academy observed it here. This Method of knowing the *Parallaxes* by Observations made at the same time in very distant places is ancient; but *Monf. Cassini* found out another, whereby one only Observer was sufficient, because that one fixed Star answers to a second. *Mr. Whiston*, a famous English Astronomer says, that this Notion has something of Miraculous in it.

These two Methods concurred in giving the same *Parallax* to *Mars*, from whence that of the Sun followed; after a long Uncertainty it was determined at ten Seconds; and consequently there is no longer room to doubt that the Distance of the Sun from the Earth is at least 33 Millions of Leagues, which is much farther than has been hitherto believed. All the Distances of the other Planets are augmented in proportion, and the Bounds of our *Vortex* removed very much backwards.

In the Month of *December* 1680, there appeared a Comet which has been famous. *Monsieur Cassini* after the first Observations told the King, in the Presence of all the Court, that it would follow the same Course as that other Planet observed by *Tycho Brabé* in 1577. He was in a manner destined to make these kinds of Predictions to crowned Heads. What made him so positive upon one only Observation was, that he had found that most part of the Comets, whether of those that he had seen, or that had been observed

served by other Astronomers, took a particular Road in the Heavens, which for that Reason he called the *Zodiac of the Comets*; and as that of 1680, appeared in that Zodiac like the Comet of 1577. He was of Opinion that this would follow that, and so it did.

In 1683, he perceived for the first time a Light in the Zodiac, which perhaps had been already observed, tho' but very rarely; but as it had only been taken for a Transient Phenomenon, it was not much regarded. As for his part, he presently conjectured by the Circumstances of this new Light, that it might be of a durable Nature; he formed a Theory of it, which taught him the Times when it might appear again, being freed and disentangled from Crepuscules or Twilights with which it is often confounded; and he found afterwards, that it might be returned to our Eyes by a matter which the Sun should protrude out of it self, much beyond the Orbit of *Venus*, in which it would be involved 'till that Distance. As this Light is not always visible at those times when it should be so, it seems as if that Derivation of Matter were unequal and irregular, like the Production of the Spots of the Sun. This Phenomenon was since observed in divers places, and even in the *East-Indies*: And if *Monf. Cassini* be not the first Man that saw it, at least is he the first who has taught others to view it, and procured to it that Attention which it deserved; nay more, he judged from the Beginning, that if this Light could be seen in the presence of the Sun, it would make it, what is call'd the Hairy Comet; this was a Consequence of his System; but perhaps, he him-
self

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self scarce ever expected to see it verified. In 1706, when there was an Eclipse of the Sun, Men saw in those places where it was total, a luminous Hairiness about that Planet, exactly such a one as Mons. *Cassini* had foretold, and which, if it were not the very same that he had foretold, was not to be accounted for at all.

In 1684, he compleated the World of *Saturn*, which had remained very imperfect. Mons. *Huygens*, in the Year 1655, discover'd one *Satellite* or *Moon* about that Planet, which was the only one a long time, but has been since found to be but the *fourth*, reckoning them from *Saturn*. In 1671, Mons. *Cassini* discover'd the *third* and the *fifth*, and was fully satisfied about them in 1673. Finally, in 1684, he discover'd the *first* and the *second*; since which there has been no more found. These Discoveries require a great Niceness in Observation, and the utmost Exactness, witness the Error into which Father *Rhita* fell, a learned Man otherwise, who took some little fixed Stars for new *Satellites* of *Jupiter*, and thereupon made his Court to Pope *Urban* the VIIIth, by naming them *Astra Urbano&aviana*, an odd Name, and which would not at all have been proper, even tho' his *Satellites* had been real. Those of *Saturn* have been thought worthy of a Medal in the History of the King, with this Inscription; *Saturni Satellites primum cogniti.*

Here follows another Event of a more singular Kind than all the rest. Mons. *de la Loubere*, the King's Ambassador at *Siam*, in 1687, having studied that Country as a Philosopher and Learned Man, as far as his short Residence there would permit,

permit, brought from thence a Method, which was there used in Calculating the Motions of the Sun and Moon. It is not performed by Tables after our manner, but by the simple Additions or Subtractions, Multiplications or Divisions of certain Numbers, of which one scarce ever sees any Relation to the Heavenly Motions, and whereof the barbarous and unknown Terms do still increase the Strangeness of the Calculation. Every thing therein is Confusion and Obscurity, which seems to be affected, and perhaps may really be so; for *Mystery is the Portion of Barbarity*. *Monf. de la Loubere* sent this frightful *Ænigma* to be solved by *Monf. Cassini*, and according to the Condition and State of Sciences at present in the East, there is all the reason in the World to believe, that altho' these Rules may be pursued there, it would have been very difficult to have found any one among them that could understand them. Nevertheless, *Monf. Cassini* penetrated into those Dark-nesses; and discover'd therein two different *Epocha's*, which they had not at all distinguished; the one a Civil *Epocha*, which fell out in the Year 544, before the Birth of *Jesus Christ*; the other an Astronomical, for the Year 638, after the said Birth. He observed very happily that *Pythagoras* was alive in the time of the first *Epocha*, he whose Opinions the *Indians* follow even to this Day, or perhaps who followed those of the *Indians*. These two *Epocha's* being found, were the Key of all the rest, but such a Key as could not be managed without great Skill. It appears by the unravelling of this Method, that those

Authors were pretty well acquainted with the Motions of the Sun and the Moon, and they could not be suspected to have borrowed so different a manner of Calculating from the Western Nations. *Mons. Cassini must have been very familiar with the Heavens to find them out in such a Disguise,*

His Enquiry into this *Indian Calendar* led him to new Reflections upon our own; with a Mind full of heavenly Motions, of Combinations and of all the Periods or Cycles that have been found out, he invented one which he called *Luni-solar* and *Paschal*, because its Effect, according to the Design of all the Ecclesiastical Calendars, was to make the Motions of the Sun and Moon conformable, with respect to the Feast of *Easter*. This brings back the New Moons to the same Day of the *Gregorian Year*, to the same Day of the Week, and almost to the same Hour of the Day for the same Place, which is the utmost exactness in the matter of *Calendars*.

Moreover, it is very Happy and even Sacred, forasmuch as it has for its *Epocha* the Year of the Birth of *Jesus Christ*; and as *Mons. Cassini* by Calculating found in that Year a Conjunction of the Sun with the Moon upon the same Day with the *Equinox*, which was the 24th of *March*, the Eve of the Incarnation, according to the ancient Tradition of the Church; this *Epocha* was at the same Time *Astronomical*, by its falling in with the *Equinox* and the New Moon, and *Civil* too, by the greatest Event that ever happen'd upon the Earth. This Period is of 11600 Years, and all the others that have been invented rolled therein. The
World

World has not seen as yet any more than about the last Third of one of these Periods, which ended upon the Day of the Incarnation ; and a little more than the 7th part of another Beginning.

Monf. *Cassini* in the Year 1693, published new Tables of the *Satellites* of *Jupiter*, more exact than those of 1668, and brought to their utmost Perfection. He added to it a very instructive Discourse upon the fine Astronomy of *Jupiter*, of which he kept nothing back. He render'd it both easy to every Body, whereas it was only so to the Astronomers before, and so nice, that most times the Observations agreed with his Calculation, even within the Minute. And accordingly these Tables that were calculated for the Meridian of *Paris*, had the Honour to be taken for a perpetual Standard established at *Paris*, which would give its immediate Observations, and by comparing them with those that were made in other Places, a great number of Longitudes were discover'd. We find that the Knowledge of this World of *Jupiter*, which is 165 Millions of Leagues remote from us, has produced that of the Earth, and has almost changed the Face of it. *Siam*, for instance, is now found to be 500 Leagues nearer to us, than it was thought to be before. On the contrary too, from the Heavenly Spaces that had been made too small, the Terrestrial had been computed too large, a natural Consequence of our Situation, and of the first Prejudices.

In 1695, Monf. *Cassini* made a Voyage to *Italy* ; at another time perhaps we might have apprehended some Returns of Tendernefs for his own Coun-

try. But as after the Death of *Monf. Colbert*, he had withstood very pressing and very advantageous Offers made him by the Queen of *Sweden*, who would have called him back thither; we were secure of his Fidelity to his new Country. He took with him the only Son that remained, and who is at present a Member of the Academy; another of his Sons had been killed at Sea the same Year, in an Engagement with an *English* Ship whilst he boarded and took her. *Monf. Cassini* did not fail to make a Visit to his Meridian of *St. Petronia*, which wanted him. The Vault which admitted the Sun was sunk, and the Hole that had been made in it was no longer perpendicular, as it ought to be. *Monf. Guglielmini* had remedied that Disorder; but since then the Pavement upon which the Meridian was drawn had lost its exact Level. In short, *Monf. Cassini* arrived there seasonably to repair his first Work, and the only one he had left to *Italy*. He was willing to extend his Cares to Posterity, and therefore desired *Monf. Guglielmini* to Publish an Instruction of all that was necessary to be done for the Conservation and Reparation of this great Instrument. *Monf. Guglielmini* did so, and therein made mention of *Monf. Cassini*, as a Scholar would have done of his Master.

This Meridian of *S. Petronia* was the 60000th Part of the Circumference of the Earth; but there was another undertaken in *France* which would be the 45000th Part of the same Circumference, and which consequently would give the Measure of the same Diameter of the Earth with such an exactness, as was never heard of, nor hoped for 'till

now,

now, but which is the Necessary and only Foundation of all the Astronomical Measures: 'Tis the famous Meridian of the Observatory, begun by *Monf. Picard* in 1669, continued by *Monf. de la Hire*, in 1683, on the North side of *Paris*, and on the South by *Monf. Cassini*, and at last carried on by the same *Monf. Cassini* in 1700, to the extrem parts of *Roussillon*. *Monf. Cassini* has had the honour of finishing it; sole Author of the Meridian of *Bologna*, and Author of the greatest part of that in *France*, the two finest Monuments that Practical Astronomy has ever raised upon Earth, and the most Glorious for the Industrious Curiosity of Men.

Our Histories of 1701, and 1704, have taken notice of that which was done at *Rome* about the *Gregorian Calendar*: The Pope order'd that the Congregation of Cardinals, to whom that matter was refer'd, should consult *Monsieur Cassini* about it; *Italy* seem'd to require back of *France* what she had given to her; and *France* upon this occasion received in the Place of *Monsieur Cassini* a Person formed by his Hands, which was his Nephew *Monsieur Maraldi*, who having a great Taste and Inclination to the Sciences, and particularly to Astronomy, came in 1687 into *France* to be with his Uncle, who was so capable of teaching him. When the Business of the Calendar was in Agitation at *Rome*, *Monsieur Maraldi* was there, and the Pope associated him to that Congregation, which stood in need of a Man that could bring *Monsieur Cassini's* Spirit along with him.

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Besides all that we have related concerning him, he has enriched Astronomy with a great number of fine and ingenious Methods, such as *the Invention of the Longitudes in 1661, by the Eclipses of the Sun*, which it was not thought could ever have been applied to that purpose; *the explaining the Libration of the Moon, by the Combination of two Motions*, one of which is that of a Month, and the other is made about its Axis in a time pretty near equal; *the manner of finding the true Position of the Spots of the Sun upon its Globe*; that of *describing kinds of Spirals, which represent all the apparent Odnesses of the Motion of the Planets, and point out their Places in the Zodiac day by day*; besides several others, which may serve for future Astronomers, as so many Means of attaining to his Knowledge, altho' they should not come up to his Capacity.

He understood the Heavens not only as they are in themselves, but such as they have been conceived by all those who have ever formed any Idea of them. If there happened to be in an Author, that did not at all treat of Astronomy, any Passages that had the least relation thereto, they never escaped him. All that was writ upon that Subject seemed to belong to him; and were it never so much concealed, he found it out and challenged it.

In the last Years of his Life he lost his Sight, a Misfortune common to him with the great *Galileo*, and perhaps for the same Reason, for nice Observations require a great effort of the Eyes. *According to the Humour of Fables, these two great Men that have made such Discoveries in the Heavens,*

may

may be compared to Tiresias, who was struck blind for having pried into some of the Secrets of the Gods.

Monsieur Cassini died the 14th of September 1712, at the Age of 87 Years and a half, without Sickness, without Pain, and thro' the sole necessity of Dying; he was of a very Healthy and Robust Constitution; and tho' the frequent Watchings, necessary in Observations, are dangerous and fatiguing, he had never been acquainted with any sort of Infirmary. *The Constitution of his Mind was just like that of his Body, even and tranquil, free from those vain Inquietudes and foolish Agitations which are the most painful and most incurable of all Diseases; even his Blindness did not deprive him of his accustomed Easiness and good Humour: A great Stock of Religion, and what is yet more, the Practice of it, did very much contribute to this perpetual Calm of his Soul. The Heavens, that declare the Glory of their Creator, never spoke more intelligibly thereof to any Body than to him; nor was any one ever more convinced of it: Not only a certain Circumspection, pretty usual to those of his Country, but also his natural and sincere Modesty would have made even the most envious Tempers pardon his Talents and Reputation; one observed in him that Candor and Simplicity which is so amiable in great Men, and yet it is more common to them than to others. He communicated, without scruple, his Notions and Discoveries, at the hazard of seeing himself robbed of them, being more desirous of rendering them subservient to the promoting the Sciences, than to his own Glory. He communicated his Knowledges, not out of vain Boasting but to make others Wiser. Finally, one might apply to him, what*

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he has observed himself in some of his Works, that Josephus said of the Old Patriarchs: That God had granted them a long Life, as well for the reward of their Virtue, as for affording them occasions of rendering Geometry and Astronomy more perfect.

His Place of Pensionary Academist is supplied by Mons. Cassini his Son.



Philosophical



Philosophical Dissertations

Extracted from the

WORKS

Of those Learned Men, whose LIVES
are Published in the First PART, and from
those of several other ACADEMISTS
still living.

PART II.

A Philosophical Dissertation upon TEETH.

Monsieur *de la Hire* the Younger, has
observed that in Adult People, the
Bone of the *Tooth* grows no more,
(which is also the Case of all other
Bones) but only the Scales or Enamel,
as he calls it: This is certain, that the *Teeth* of an
Old Man taken out of their Sockets, are no longer
than those of a young or middle-aged Man.

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The Scales of the *Teeth* are a Substance quite different from the Bone, they are composed of an infinite number of little Fibres or Threads which are fasten'd to the Bone by their Roots, in a manner like Nails and Horns. This Construction is easily seen in a broken *Tooth*, in which one may observe that all these Fibres which take their rise near that part of the Bone that touches the Gums, are much inclined to the Bone, and as it were lying upon each other, so that they are almost perpendicular upon the Basis of the *Tooth*, by which Means they are better enabled to resist the Effort they are obliged to make in that Part.

Monfieur *De la Hire* is of Opinion, that the Increase of these Fibres is made after the same manner as that of the Nails. If by any Accident a little Part of the Enamel or Scale is broken, so that the Bone be left naked, that is to say, the Roots of the Fibres of the Scale be carried away, the Bone will grow rotten in that place, and the *Tooth* must absolutely perish, without any possibility of saving it, for the Bones in Animal Bodies can never bear to be naked.

There are, however, some People the Scales of whose *Teeth* are worn out, perhaps with much rubbing them, the Bones of which appear without Perishing: But the reason of that is, because they are not actually naked, and because there does still remain a very thin Scale sufficient to preserve them. But the Layer is so thin as to be transparent, and you may see the Yellow Colour of the *Tooth* through it.

Sometimes

Sometimes the *Teeth* are broken, and the Bone exposed without any Inconvenience; but the Reason of that is, because they are stopt, that is to say, the Root of the *Tooth*, into which a little Branch of the Nerves come, being entirely stopt, all Communication between that Branch and the Source of the Nerves is interrupted, and consequently all Sensation. The *Teeth* are not thus stopt but in Old People.

It may happen that in some *Teeth*, the Fibres which compose the Scale, are only united in the extream Parts, but not exactly next the Bone, as appears plain enough in the Basis of those *Teeth* that are called the *Grinders*, in which you may see the Separation of the *Lamina*; but the extream Parts of the Fibres being worn away by little and little, if the Separation between two *Lamina* should be made large enough to receive any of the little hard Particles of the Food, that will cause a little Hole in the Basis of the *Tooth*, and consequently the Bone being uncover'd will perish in Time; this may be a little helped, by stopping the Hole with Lead, which hinders the Acruous Food from penetrating to the Bone, and causing Pain in it.



Upon the Feathers of BIRDS.



A Philosopher might be a long time Examining the minutest Objects in Nature, without being able to exhaust them. You will be convinced of this Truth by the following Reflections, which the *Feathers* of *Birds* have suggested to Monsieur *Poupart*, and which would have been much more numerous if he had traced the Matter as far as it would have led him.

Feathers are nourished by the Blood, and the Lymph or watry Humour; this will appear in dissecting, with a little Care, any one of the great *Feathers* of a large Young Bird, that has still its *Down*; but there is yet a more easie way to discover it, for If you squeeze the same Feather from one end to the other, you may make the Lymph and Blood drop out of it.

The Bird must be Young, as well as the Animal, in which you would observe how the Bones are nourished. The Vessels in the *Feathers* and the Bones are dried up visibly, and the Mechanism disappears proportionably as those Parts grow more perfect.

At the End of the Tube of the Feather, is a little Hole, by which the Blood-Vessels enter, after the same manner as they enter into a *Tooth*, by a little Hole which is at the extream Part of the Root. That dry and light Substance, which is found within the Tube or Quill of a Feather, when
it

it is cut to make a Pen of it, is in Young Birds a great Fleſhy Channel, like a Vein filled with Lymph, about which the Blood Veſſels, which enter into the end of the Tube, creep and divide themſelves into a thouſand little Branches. But if you would know what this large Carnous or Fleſhy Channel is, you muſt not examine it in Young Birds, but in the grown ones; the Point of View, in which you muſt place your ſelf, is no longer the ſame.

In grown Birds we may obſerve this Channel to be compoſed of ſeveral little Bags or Sacks tranſparent, ranged one above another, and diſpoſed in ſuch a manner, that the Bottom of the Lower is joyn'd or faſten'd in the Mouth of the Upper, and ſo on quite to the Top of the Quill. But when you come near to the Beards of the Feathers, theſe little Bags become like Tunnels, at leaſt in ſome kinds of Birds, as in Turkeys. The Tube of the Lower Tunnel inſinuates it ſelf into the Caſe of the Upper, and is faſtened to the Bottom of it; and the Tube of the laſt Tunnel enters into the Marrow of the Feather.

The Blood Veſſels diſcharge their Lymph or Water into theſe little Bags, and from thence they are filtrated, even to the Top of the Quill, and ſo enter into the Pith of the Feather, which being nothing but a ſpongy Matter, eaſily ſucks it up, and diſtributes it on all ſides into the Beards.

In Turkeys this Pith, or Marrow, is nothing but a Collection of an infinite Number of little Channels, which are obvious enough, for the Parts of the Organs of an Animal are themſelves Organized, ſo that the Composition of the Mechanifm or Structure

ture of Bodies is infinite, and there is hardly room to doubt but that in all other Birds, in which the Channels of the Pith of the Feather are not visible, they are nevertheless to be found, and do perform the same Functions.

Monsieur *Poupart* has observed, that one single Feather of a *Vulture* with its Down yet upon it, weighed more than six other Feathers of the same Size that were come to Perfection, so much was it loaden with Nutrimental Juices; and from thence he concludes, that as the Feathers are Instruments absolutely necessary to Birds in seeking for their Food, Nature makes hast to compleat them, and Labours therein with more Diligence than in the most part of her other Works. It would have been a Satisfaction great enough in it self, to see, that the hollow of a Quill had been so wrought by Nature, as to unite at the same time, the Strength thereof with its Suptilness and Lightness: But we have moreover discovered that such a Cavity serves for a Magazine to the Nourishment which is to be distributed throughout the whole Feather, and that the same Means answers very different Ends at the same time.

It is moreover a very curious thing to observe the Care taken by Nature, in preserving the new born Feathers of Young Birds. The Beards of those Feathers are at first no more than a kind of Pap, so tender and delicate are they; they are therefore rolled up, in a long Cartilaginous Tube, fill'd with Moisture, to the end, that they might not be exposed to the Air, which would dry them and close up their Pores in such a manner that they could no longer receive any Nourishment: But
when

when they are grown strong enough, so as to resist the Impression of the Air, the Case in which they were involved, and which then becomes useless, dries away, and falls off in Scales of its own accord.

Upon INSECTS.

Insects appear contemptible to the Vulgar; who never know how to apply rightly either their Esteem or Contempt. They are most commonly placed under the Class of Imperfect Animals; but Philosophy judges them to be so much the more worthy of its Attention, as they seem to have been formed by Nature in a very particular Mold.

For it is only they that for instance change their Species, and after having crept upon the Ground are exalted into the Air, assuming a new and more noble Life. What Monsieur *Hombert* has observed upon the odd Coition of those Flyes that are called *Demoiselle*, may serve to teach us what a fruitful and inexhaustible Fund of Mechanical Inventions Nature has produced to attain to all its Ends.

To be of both Sexes at once, and to perform the Functions thereof at the same time, seems to be what is reserved hitherto for Insects only. *Mont. Poupert* gives us a Catalogue of all the Kinds in which he assures us this Singularity is to be found. Such are *Earth-worms*, *Worms found in humane Bowels*, and in those of *Horses*; *Land-Snails*, and those

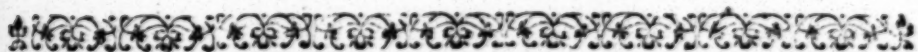
those of fresh-water; and all Kinds of Leaches; and for as much as all these Insects are Reptiles and have no Bones, *Monsieur Poupert* concludes, that probably all others of the same Character are likewise Hermaphrodites; for tho' Nature delights so much to vary the Kinds of Animals; yet she preserves enough of Uniformity among the Species of the same Kind, especially with respect to their principal Characteristicks.

Not but that there are some creeping Insects without Bones that are not Hermaphrodites, such as those that produce Flyes, Silk-worms, and other Animals: And these are so far from being Hermaphrodites, that they are of no Sex at all, and to speak properly, they ought not to be called Animals, being only Cases or Masks, in which real Animals are involved and hid; and out of which you see them shortly issue, adorn'd with Wings. If these Worms appear sensible, perhaps that Sensibility only belongs to the concealed Animal, and not to the outward Case. Be that as it will, the Worm which is to become a Butter-fly, is neither Male nor Female, nor does it engender whilst it is in that State, but waits for its Metamorphosis.

For an Example of the Observations that may be made about the double Sex of Insects, *Monsieur Poupert* gives us the following, upon the Copulation of *Earth-worms*: These little Serpents slide by Pairs into such Holes as are convenient for them, where they adjust themselves in such a manner, that the Head of the one is opposite to the Tail of the other; then they approach in a streight Line to each other, and as soon as they are joyn'd,

joyn'd, a little Protuberance or Button in the form of a small Cone, is thrust into a little Orifice of the other, and so reciprocally. One may see very plainly the mutual Insertion of those little Buttons, if one takes the Worms into ones hands, and separate them gently from each other at the Parts where they are joyn'd, viewing them in a good Light. They couple in Spring, and you find the Biggest in fat and moist Soils.

As these Creatures are Males at one end, and Females at t'other, and their Bodies easily folded, *Monf. Homberg* thinks it is not impossible that one Worm should copulate with it self, and so become both Father and Mother of the same Insect. *This is a strange kind of Generating; but perhaps it is only our Ignorance that makes it appear so strange, and who can tell the Bounds of that Variety with which Nature is pleas'd to inform her Works?*



Upon that Kind of Madness which is called
HYDROPHOBY.

THE Hydrophoby or Aversion for Water which attends Madness, is one of the most surprizing Symptoms we meet with in any Distemper. What Relation, what Connexion can there be between the Poison that is conveyed into the Blood by the biting of a Mad Dog, and that Horror for liquid Things that render the sight of them unsupportable to the diseased Person, throwing him into convulsive Motions, and into violent Rage and Fury?

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Monfieur *Tauvry* having vifited for fome Days a Young-man that had been fo Bit, and whole Death he had pronounced Infallible, open'd him, tho' in haft, and endeavour'd to difcover by Diffection fomething that might have relation to this Hydrophoby.

The infide of the *Oefophagus* was inflamed, the *Trachea* likewise a little; at the bottom of the Stomach, there was about three Spoonfuls of a dark, brown pituitous Matter, like that which the Perfon vomited up. The *Gall Bladder* was very full of Bile almoft Black. The *Pericardium* had very little Water in it. The Arteries were very full of a thin liquid Blood, and the Veins no lefs empty; there was no coagulated Blood found in any Part. After his Death, his Blood would not coagulate in the cold Air, whereas that which was drawn from him a few Days before, was eafily coagulated. The Brain, and almoft all its Parts, were much drier than ordinary, and fo was the Spinal Marrow at its upper part, and all the Mufcles of the Body.

Upon thefe Facts, Monf. *Tauvry* grounds the following Conjectures: The Spittle and Bile are probably the firft Liquors that are infected with the Poifon; the Patient had vomited a mixture thereof which excoriated and inflamed the *Oefophagus*. From thence might proceed his Averfion to any Nourifhment, whether folid or liquid, which he could not take in without Pain; but chiefly to Liquids, becaufe they diffolved the noxious Salts involved in the Bile and in the Spittle.

It is very likely, that the Nature of this Poifon is to diffolve the nutritious and balfamick Parts of the

the Blood, after which the Body is no longer nourished, and the Veins being dried up for want of Nourishment, are closed, and do not yield an easy passage to the Blood which they ought to receive from the Arteries. That Blood being kept in the Arteries too long a while, and in too great abundance is continually beaten, compressed, and more minutely dissolved therein, than it was at first by the sole Dissolution of its Balsamick Parts.

On one hand the Brain and the nervous Parts are very little moisten'd by that Blood which has hardly any thing but Spirits in it ; on the other, those Spirits fly up towards the Brain in great Quantities, and with an extraordinary Rapidity. It is easy to perceive how that produces both Convulsions and Madnefs : The Seat of the Soul being all on fire.

Palmarius by the Account Monsieur *Tauvry* gives of him, affirms, that those who are infected with the Hydrophoby, can't bear the sight of a Looking-glass, or any Thing that is transparent ; 'tis because those Objects which naturally make a lively Impression, make it at that time too strongly upon a Brain too much extended and inflamed. Waters and other Liquors are Transparent and have besides a Motion that may easily disturb very moveable Organs.

The System of this Distemper, may guide one to the Invention of Remedies, and it is by so much the more Lawful to make Experiments in these Cases, as the Death of the Sick man is infallible if nothing be done to him.

Monf. *Tauvry* is of Opinion, that the hot and sharp Medicines which are commonly used are very
Q 2 bad,

bad, especially if you except the Sea-salt, which may in some measure maintain the Connection of the Parts of the Blood; nor does he think that Water is good in this Disease; his Patient always finding himself worse after he had drank of it; it is therefore safest in such Occasions to follow the instinct of Nature. Probably the Cure might be facilitated by Emeticks, if one could make them stay any time in the Stomach; his Patient always found Ease after having vomited pretty freely. Perhaps a good Quantity of Mercury might remove the Obstacles which the closing or contraction of the Veins causes in the Circulation of the Blood. Perhaps it might not be amiss to use Precipitants, to correct the Acrimony of the Spittle or Bile; after which the use of Milk will restore to the Blood those nutritive Parts of which it had been divested.

This Matter having been debated in the Academy, several Persons gave an account of remarkable Cures of the same Distemper that had fallen under their Observations.

Monf. *Poupart* relates that a Madwoman having been blooded till she fainted, and afterwards tied in her Chair for the space of a Year, and fed with nothing but Bread and Water, recover'd: Monsieur *Berger* affirmed, that among several Persons that had been Bit, Two were cured by being blooded in the Forehead, but that the rest died; Monf. *Du Hamel* said that Salt-water applied to the Wound was sufficient.

There were likewise Instances given of People that had been cured of their Horror for Water, by pouring great Quantities of Water upon them; and

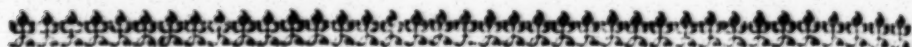
and particularly of one Man whom they had tied to a Tree, and thrown 200 Pails of Water upon his Body, without any other Preparation.

But the best circumstantiated Account, was *Monf. Morin's*, about a young Woman of Twenty Years, who had been bit in the Hand by a little mad Boy. She had all the Accidents of Madness, and at last 16 Days after the biting, they put her into a large Bath of River-water, which was rather cold than warm, and in which they had dissolved a Bushel of Salt. She was thrown into it quite Naked and then taken out again, and this was repeated so often, 'till she was extreamly tired therewith; and so they left her sitting in the Bath and quite stunned. When she came to her self, and looked upon the Water in which she was sitting, she was amazed that she could see it without any Emotion.

After this, there happen'd nothing but what was common in her Distemper. She had a Fever, which was handled according to the usual Method. She had frequent Inclinations to Vomiting, the Physicians helped Nature, and she found Ease by those Evacuations. In short, they made a perfect Cure of her, and her whole illness did not last above a Month. *Monf. Morin* took this Account out of the Journal of *Monf. Raoult*, Surgeon to the Hospital called *L'Hôtel Dieu*, who had attended the Patient during all the time she was ill.

It seems that the Imagination so furiously shockt with Water, and all other Liquid matters being once subdued and brought to endure those Objects with Patience, the greatest Difficulty of the Cure is surmounted; as well because the Spirits
Q 3 being

being no longer irritated and inflamed at the Sight of them, cease to carry the Disorder throughout the Body, as because the distemper'd Persons do thereby become more Tractable, and do more readily submit to the Medicines and Diet that are most proper for them.



*Upon the PARALLELISM of the TUFFT
of TREES, with the Sun which they shade.*

IN Proportion as our Eyes are adapted to make Observations, Miracles encrease and multiply upon us. In several Fruit-trees, such as that of the Apple, Pear, Chesnut, and generally in all those that imitate their manner; as Walnut-trees, Oaks, &c. the Basis of their Tufft does almost always affect to be parallel with the Plain from whence the Body of the Tree issues, whether that Plain be Horizontal or not; or whether the Trees themselves be perpendicular or inclining to an Angle with their Plain; and this affection is so constant, that if a Tree grows in a place where the Plain is on one side Horizontal, and on the other inclining to the Horizon, the Basis of the Tufft will likewise be Horizontal on one side, and on the other incline it self towards the Horizon in the same proportion as the Plain does.

These Facts have offer'd themselves to a great many Eyes that were not capable of observing them; but they could not escape the Vigilancy of Mons. *Dodart*, who knew how to consider them
with

with Admiration ; and having enquired into the Cause he has formed the following Conjectures.

In the first place, he observes that the branched Roots follow the Surface of the Plain out of which the Tree springs, in whatever Position that plain is ; and that they rarely extend themselves but between two Earths where they meet both with their Substinance, and with less opposition than if they thrust themselves downwards. Consequently the Projection of the Roots ought to be accounted parallel with the Plain on which the Tree stands.

He next considers the Roots, the Trunk and the Branches, as composed of the same Fibres strait and parallel among themselves, and which are extended from the extreamest Parts of the Roots along the Trunk quite up to the ends of the Branches.

In this Supposition, these Fibres do necessarily make two Folds or two Angles, one at the Neck of the Root, the other at the Neck of the Branches. Since then the Roots are always parallel with the Plain that bears the Tree, if the Tree be perpendicular to the Plain, it is so likewise to the Projection of the Roots ; if it be inclined to the Plain, it is equally so to this Projection. It is clear, that in the first Case, the Fibres, supposing them continued from the Extremity of the Roots quite up to that of the Branches, make on one part, and on the other, two Right Angles with the Neck of the Root ; and in the second Case, two Angles, one whereof is Obtuse, the other Acute.

The only Question is to know, why the Basis of the Tufft of the Trees is always parallel to the Projection of the Roots, and why, when this Projection makes with the Body of the Tree two un-

equal Angles on the one Side and on the other, the Tufft of the Branches makes with the same Body the same Angles disposed alternately, as it is necessary for the sake of the Parallelism.

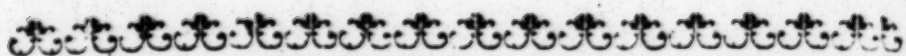
Touching that Question, *Monf. Dodart* is of the following Opinion : On the side where a Tree makes an Obtuse Angle with its Plain, and consequently with the Projection of its Roots, a Fibre proceeding from the Extremity of the Root, and continued to the Extremity of a Branch, does necessarily make the same Obtuse Angle at the Neck of the Root. If it should likewise have made an Obtuse, or even a Right Angle only at the Neck of the Branches, it is plain, that it ought to be much longer. Now the Fibres of the Wood may be easily bent, but can't be extended ; wherefore that Fibre, which made an Obtuse Angle at the Neck of the Root, must at the Neck of the Branches, and on the same side make an Acute one, that being the Complement of the Obtuse, that it may not increase its length, and to preserve its self in the same Condition, as if it had regularly made two right Angles at the two Necks. The acute Angle of the Branches being the Complement of the Obtuse of the Roots of the same side ; it is plain that the Branches and the Roots are parallel.

On the other Side, where the same Tree being inclined makes an acute Angle with its plain, and where a Fibre makes one likewise with the Neck of the Root, it is certain by the Phenomenon in question, that it makes an obtuse Angle at the Neck of the Branches. But it is not easy to explain this obtuse Angle, why this Fibre being in
some

some measure loosen'd by the acute Angle it makes at the Neck of the Root, should recover it self to make an obtuse one at the Neck of the Branches? What obliges it so to do? Why does it not persist in its State of Releasement, and why does it not make a second acute Angle at the Neck of the Branches?

Monf. *Dodart* who raises this Objection, answers it thus: That on that side of the Tree the inclination or bent formed by the Fibres laid upon each other from the Centre of the Tree quite to its Bark, is by so much the less Acute, less close and less round, as the Fibres come nearer to the Centre; that those which are the nearest to the Surface may indeed be more relaxed or loose, but that the others which embrace them are stretched by the greatness of the bent, and that consequently they tend to recover themselves at the Neck of the Branches, and there to make an Obtuse Angle. It must be supposed that the Fibres which have this Disposition, are much more numerous than the others, whereby they force them to their own Accommodation.





Upon the Salts of PLANTS.

Here are Essential Salts of Plants, that is to say, Salts that are extracted from them without the Action of Fire; and they are so like in their Effects to Salt Petre or Common Salt, that they seem to have been suck'd from the Earth by those Plants in the very Figure in which they appear, and without having undergone any Change; but on the other Hand, how comes it to pass that two neighbouring Plants, very different from each other, should be equally well nourished in the same Soil if they dont each of them change, and convert to their peculiar Uses, the Juices which they draw from them? To solve this Doubt, Monsieur *Hornberg* took some good Garden Mold, which he washed with several boiling Waters to divest it of all its Salts as far as it was possible; then he divided eight hundred Weight of the said Earth, into four equal Parts, and put it into so many Pots; he sowed two of the Pots with an equal Quantity of Garden Cresses, and the other two with Fennel. Finally he watered one Pot of Cresses and one of Fennel with Water, in which he had dissolved some Salt Petre, insomuch that there went at least two Ounces of it to each Pot; on the two others he only bestowed pure Water.

This was therefore a sure Method of comparing together two Plants very different, that had drawn nothing but the same Salt from the Earth, and at the same time, a Plant nourished in a fresh and insipid

insipid Earth, with it self, when nourished in an Earth impregnated with Salt Petre.

The Event made this Comparison; at first, the four Pots throve equally; when the Cresses arrived at the height of seven or eight Inches, Monsieur *Homberg* pulled it up, and found that which was produced by the insipid Earth to weigh 25 Ounces, and that in the other 27 Ounces $\frac{1}{2}$ there was no difference in the Taste, but by the Chymical Analysis the Cress that was water'd with Nitre, yielded a little more of Active Principles; but the difference was so small, that it may pass only for that which is unavoidable between two Analyses.

Monsieur *Homberg* suffered the Fennel to grow longer than the Cress, and the difference was much greater between the two Pots of Fennel than between those of the Cresses; the Fennel water'd with Nitre was one third Taller, of a much finer Green, and weighed two Pound, whereas the other weighed but 19 Ounces.

Monsieur *Homberg* explains, in a manner probable enough, the very great Difference that happen'd between the two Pots of Fennel, and those of Cresses; which was, that the Fennel grew a longer space of time. When the little Plant, as yet Imperceptible and nevertheless compleatly formed already in its Seed, begins to be unfolded, it draws all its Nourishment from the very Substance of the Seed, till that Substance being quite spent, the Plant which is now become stronger, begins to attract the Juices of the Earth. It was shut up with that little stock of Provision, by which it was to subsist during some time, after the same manner exactly, as the

the *Fetus*, inclosed with its *Placenta*, is nourished till the Birth, by the Juices it receives from thence.

While two Plants are young enough to live upon their own Seed, their Condition is equal; but when that little Magazine is exhausted by them both, if they meet with Earth differently disposed, they thrive unequally, and so much the more unequally, as they are the longer fed by nothing else but those different Earths. This may easily be applied to the two Pots of Cresses and the other two of Fennel.

By the Chymical Analyses, the difference of the active Principle between the two Pots of Fennel was much greater than that between the two Pots of Cresses.

The Cresses, which are of an Alcaline Nature, yielded Principles that were very Alcaline, even those that were water'd with Nitre, in which there is beyond doubt a great deal of Acid.

The Fennel, which is of an Alcaline Nature, yielded a great deal of Acid in all its Principles, even that which grew in the fresh Earth.

From thence it is easie to conclude, both that the Earth is never thoroughly divested of its Salts by simple Washings, and that the greatest Part of the Salts contained in Plants, are there formed, such as they appear to be either by the natural Fermentations they meet with there, or else by the different Organs through which they are filtrated.



Upon the Formation of the VOICE.

FOR the Production of *Sounds*, the first thing required, is Air moved with a very great Swiftneſs, for a Sound moves a Hundred and eighty Fathoms in a Second, or the 60th part of a Minute; that is to ſay, in an Hours time according to the ſame Proportion, it would extend it ſelf as far as 283 common Leagues of *France*, if not ſtopt by any foreign Cauſe. This has been tryed.

All the Conjectures, and all the Phyſical Diſcourſes tend to convince us, that ſuch a Motion cannot be impreſſed upon the Air, but by the brisk and lively Vibrations of the ſmall Parts of the ſonorous Body, which by ſome Cauſe or other, have been put into an Elastiſcity or Springineſs.

The diverſity of theſe Vibrations modifies the Sound and makes the different Tones: A great number of Vibrations made at the ſame time produces an acute, or ſharp Note.

It is known that a String always equally ſtretched, makes in an equal Time ſo many the more Vibrations as it is ſhorter; or if its Length is always the ſame, ſo many more Vibrations, as it is more extended. Two Strings of an equal tenſion, the Lengths of which are as 1, to 2, ſound the Octave of each other. If the Lengths are as 2, to 3, as 3, to 4, &c. then the Strings ſound a 5th, a 4th, &c. Theſe relations of 1, to 2, of 2, to 3, of

of 3, to 4; in short, all the relations of Lengths of Strings from whence there results the accords or agreements of Musick, may be called *Harmonical Relations*.

Since the relation of 1, to 2, makes the Octave, that of 1, to 4, will make the Double Octave; that of 1 to 8, the Triple Octave, &c. and the same in the other Relations. And one may say, that these last Harmonical Relations, for instance, 1, to 4, 1, to 8, &c. are of the distance in Comparison of 1, to 2. Two Strings, the Lengths of which are equal, do likewise make different Accords, in proportion to the difference of their tension; but it is not upon tensions that the Subject of this Discourse will chiefly turn. They are regulated in respect to the Accords of Musick by another Proportion than that of the Lengths.

The Sound that strikes our Ear, is not only that which comes directly from the sonorous Body to us, but likewise that, which being gone out of the sonorous Body has been striking upon all the neighbouring Bodies, and is from thence reflected towards our Ear. For altho' this reflected Sound has more Way to make, before it comes to us, than the direct Sound; the difference of the time is wholly Imperceptible to us in small Distances, by reason of the extream quickness of this Motion, unless our Sensation be very nice and fine; inso-much that it confounds the two Sounds; tho' at the distance of some small space of Time this Imperfection is even an Advantage, since the two Sounds being United do fortify themselves considerably. *The Wisdom of Nature sacrifices one Advantage which would be of little use to us, to another that is much greater.* The

The reflected Sound does so much the more strengthen the Direct, as the Vibrations of the reflecting Bodies have made with those of the sonorous Body in the same time, a nearer Harmonical Relation; as of 1, to 2, of 2, to 3, &c.

It may even happen that the reflecting Bodies being much more proper to produce Sounds than the sonorous Body it self is, the Sound which they produce may be stronger than that of the sonorous Body, that the Tone which they take, may surmount the other's, and render it insensible to the Ear, and in short that the Tone that is heard may be that only of the reflecting Bodies, altho' they were not the Origin of the Sound.

Wherefore it is much more likely that the Tone may be composed both of that which proceeds from the sonorous Body, and of that also of the reflecting Bodies.

This System of Sound being supposed, Monsieur *Dodart* enquires after what manner the humane Voice, and its different Tones are formed.

In our Throat and at the top of the *Arteria Trachea*, or Wind-pipe, which is the Canal whereby the Air enters into the Lungs, there is a little Oval Chink or Cleft, capable of opening it self more or less which is called the *Glotta*.

The long Canal of the *Trachea* terminated at its superiour Extremity by the *Glotta*, does so much resemble a Flute, that the Ancients did not stick to believe that the *Trachea* produced the Voice, as the Body of a Flute produces Sounds. *Galen* was the first that overcame so natural an Error, and maintained that the *Glotta* was the principal Organ of the Voice, allowing nevertheless to the *Trachea*

a considerable Share in the Production of Sounds ; for it rarely happens that he who is the first undeceived of a vulgar Opinion, can free himself entirely from it, and old Prejudices do commonly leave some Footsteps upon his Mind.

But Monf. Dodart consider'd that Men do not Speak nor Sing neither, but by exploding the Air, and not by admitting it ; that then the Air which goes out of the Lungs passes from the smaller Vessels of that Part into others always larger, and from thence into the *Trachea*, which is yet much bigger and larger ; that consequently its Course becoming still more free and easy, and being more than ever so, in the *Trachea*, the Air in that Canal will be far from suffering the Violence and acquiring the Swiftneſs necessary to produce Sound ; but as the Orifice of the *Glotta* is very small with respect to the largeness of the *Trachea*, it cannot come out of the *Trachea* by the *Glotta*, without very much augmenting its Swiftneſs, and precipitating its Course ; and thus it violently agitates, as it passes the little parts of the two Lips of the *Glotta*, puts them into an Elastic Motion, and makes them make Vibrations, which are the cause of Sound.

This Sound so formed, eccho's or resounds in the Cavity of the Mouth and Nostrils, and Monsieur Dodart observes, that all the agreeableness of the Voice depends upon this ecchoing ; that when one speaks, and at the same time stops ones Nose, the Voice becomes very disagreeable, and that the common Notion that speaking thro' the Nose is offensive, is very false ; since on the contrary, the Sound is only then Shocking when

when the Mouth alone, and not the Nose, has any share in it.

To the end that the *Trachea* may make the *Eccho*, it is necessary that the Air modified by the *Glotta*, in order to become a *Sound*, instead of continuing its way from within to without, should return from without to within, and strike upon the sides of the *Trachea*; but this is what never happens, except in those that have a violent Cough; or that, according to the common Expression, speak from the Belly. In the first, the irregular Convulsions of the *Glotta*, shut it up when the Air is going to come out, and oblige it to return back, from whence it does not come out again, 'till after it has fortified it self by the Reflexions of the Concavity of the *Trachea*. In the others, 'tis nothing but a habitude assisted perhaps by some natural Disposition, and which produces in them when they have a mind to it, that which otherwise is only an involuntary accident.

It is true, that in the greatest part of the *River-Birds*, which have a very strong Voice, the *Trachea* resounds, but the reason of that is, because the *Glotta* is placed at the bottom of the *Trachea*, and not at the top, as in Men.

Thus the Canal, which had passed at first for the principal Organ of the Voice, will not even be allowed to be the Second, and an Accessory, that is to say, that which makes the *Eccho*; and it will only serve to furnish Air like the Bel-lows of an Organ.

Nothing more remains than to find the Cause of the different Tones; and since the Organs, which form the Voice are, as one may say, Wind-

Instruments, *Monf. Dodart* goes on to enquire what it is that forms the Tones or Notes in Wind-Musick.

It is possible, as we have said above, that the Tone may proceed from the Body that ecchoes, and not from that which sounds first. The *Hautboy* would yield no Sound, if it had not its *Quill*; and if he that plays upon it, by driving the Air thro' the Orifice of that *Quill*, did not cause Shiverings and Vibrations in the two little thin and very moveable Leaves whereof it is composed. But the Tone does not proceed but from the length of the *Hautboy*, and the Air agitated by the *Quill* in the Concavity of the Instrument, strikes the internal Sides of it, shakes the Fibres of the Wood disposed length ways, makes them shiver, and exerts a lower Tone when they are longest, and a higher when shortest.

The *Quill* has nevertheless a Tone of it self, but the direct Sound which it renders being very much exceeded by the infinite number of Reflections which the Concavity of the Instrument produces, all that is required of Art to do in the Matter, is, that the Tone of the *Quill* should not make a Dissonance with that of the *Hautboy*, but that it should agree with it, according to some remote Harmonical Relation; for in this case there can be no other, and that thereby it should second and fortifie it as much as possible. The Players upon the *Hautboy* cannot find this Proportion, but by feeling softly. So likewise in the Stops called *Biseau de l'Orgue*, it is a *Quill* which makes them Speak, and the Length alone of the Pipe gives them the Tone.

There

There are on the contrary two Stops of the Organ, the *Regal* and the *Humane Voice*, where the *Quill* alone gives the Tone by the length of its Motion; and it is necessary that the Pipe should agree with it, according to some remote Musical Proportion, which those who make *Organs* cannot yet discover by any exact Rules.

In the great Stops of the *Quill* of the Organ, *la Trompet*, *la Cromborne*, and *le Clairon*, the Tone proceeds equally, both from the Dimension of the Tube or Pipe, and from that of the *Quill*. But in short, what can one find in the natural Instrument, which produces the Voice like that which makes the Tone in all these different Instruments?

One cannot, according to this Analogy, attribute the Tone but to the *Mouth* and *Nostrils*, which make the *Eccho*, or to the *Glotta* which makes the *Sound*; and as all the different Tones are produced in Men by the same Instrument, the Part producing them must be capable of Changes conformable to them.

There is more Air required for a low Tone than a high one; the *Trachea*, to facilitate the Passage of this greater quantity of Air, dilates and shortens it self; and in so doing, it lengthens the Canal of the Mouth. On the contrary, for a high Tone, it narrows and lengthens it self, and so allows the Canal of the Mouth to be shorten'd.

One might then suppose that the Canal of the Mouth being lengthen'd for the grave Tones, and shorten'd for the sharp ones, is exactly disposed as it should be for the Production of Tones.

But Monsieur *Dodart* observes, that in the *stop* of the *Organ* called the *Humane Voice*, where the *Quill* alone makes the *Tone*, the longest *Pipe* has Six Inches, and is not capable of giving the *Tone*. The Concavity of the Mouth of a Man that has the lowest *Base*, is not above Six Inches in Depth ; it is not therefore likely, that that can give the *Tone* ; there remains then only the *Glotta* that must form the *Tones*, as well as the *Sound* ; and that can only be by the different *Changes* of its *Orifice*. It is *Oval*, and capable of *Extension* to a certain *Degree*, as also of *Contraction*, and thereby the *Fibres* of the *Membranes* which compose it are lengthen'd out for the *Low* and *Base* *Tones*, and shortened for the *High* and *Treble* ones.

At the same time the Mouth which is lengthen'd for the *Low* *Tones* and shorten'd for the *High*, adapts its *Resounding* to all the different *Tones*, at least according to some remote *Musical Proportion* ; and *Nature too wise to neglect any thing, has made an advantage even of this Resounding*.

The *Construction* of the *Telescope* resembles the *Structure* of the *Eye* ; speaking *Trumpets* seem to be form'd upon the same *Plan* as the *Concavities* of the *Ear* ; but no *Wind Instrument*, that ever came out of the *Hands* of the *Artificer*, is of the same *Structure* with that which *Forms* the *Voice* of a *Man* ; none of them can produce their *Tones* by *Changes* made in one and the same *Orifice*.

It seems even as if *Nature* intended to place this *Instrument* above and beyond all kind of *Imitation*. In the first *Place*, it would be difficult to find, in the *Hands* of *Art*, any *Materials* so flexible as that one could make in them an *Orifice* capable

capable of being changed every Moment; and as the Changes must be, for every Tone or Note, exceeding nice and exact, the Difficulty would be invincible; but besides, when we shall see by an exact Calculation of Monsieur *Dodart*, that for all the Tones and Demi-tones of an ordinary Voice, for all the small parcels of a Tone, which may serve to raise an Octave without any Violence (for the more or less Force that one may give a Sound without changing the Tone, one must necessarily suppose that the little Diameter of the *Glotta*, which is at least the Breadth of one Line, and which alters its Length in all these Changes, may be, and is actually, divided into 9632 Parts) that even these Parts are not equal, and consequently that some of them are much smaller than the $\frac{1}{9632}$ part of a Line; how is it possible that the Art of Man can ever attain to such nice and delicate Divisions; and it is surprising, that even Nature it self can perform them. On the other hand, it is no less wonderful that the Ear, which has so just a Sensation for Tones, can perceive a Difference, the Origin of which is no more than the $\frac{1}{9632}$ part of less than one Line.

In this whole Calculation Monsieur *Dodart* has put every thing upon the lowest Foot, carefully avoiding the Affectation of *Wonderful*, notwithstanding which, he could not help bringing his Calculation to such a prodigious Number.

We must not believe that the Fibres of the *Glotta*, to take, for instance, the Fifteenth or Flagelet of a Low Tone, are to be reduced to half their Length, or do shorten in proportion the little Diameter of the Orifice of the *Glotta*. That would be true, if those Fibres did produce the Tones on-

ly by their different Lengths, but they do it likewise by their different Tension. Thus they sound the *Fifteenth*, without being reduced to half their Length, because they are at the same time more extended, and that which is wanting by the precise Measure, is exactly supplied by the Tension: But finally they are not more stretched than at the same time they shorten themselves.

The Shortnings of the little Diameter of the *Glotta* follow all the Changes that happen to them, the number of the 9632 Divisions of this Diameter subsists, and the Miracle of the Formation of the Tones increases; because a Mechanism which depends on the just Complication of the Length, and of the Tensions, of which even the Proportions are different, is more difficult than if it did depend on but one alone of these Principles.

But what will it be when one considers that the whole Man is a Collection of Miracles, either like those above-mentioned, or of equivalent ones, the number of which is much greater than that of the Divisions of the Diameter of the Glotta.





*Upon what becomes of the AIR that is received
into the LUNGS*

T every Respiration new Air enters into the Lungs, which mixing its self with the Blood that is carried to the Heart by the Pulmonary Veins, comes out of the Heart again with the same Blood, accompanies it into all the Arteries where it is distributed, and communicates to it the Impulsion and Swiftneſs neceſſary for the Circulation.

But when that Air is at laſt arrived at the Extremities of the Arteries, and at the Internal Surface of the Skin, *what becomes of it?* For it ought finally to go out of the Body, ſince each Reſpiration bringing new Air into it, there would at length be ſuch a quantity of it, as would ſwell the Veſſels too much, force their Elastic Power ſo as to make them loſe it; and would ſtop the Blood, or at leaſt render the Circulation very painful.

There does not appear much difficulty in this Matter; ſince the Pores of the Skin ſuffer the Sudorific Matter to paſs th'ro' them, and eſpecially that of the inſenſible Tranſpiration, which comes out in ſo great a quantity, that it exceeds in one Day only, according to the niceſt Experiments that have been made thereof, all the groſſer Evacuations of ſeveral Days; it is eaſie to comprehend, that theſe ſame Pores may at the ſame time filtrate thro' themſelves ſo fine a Subſtance as that of Air.

As this Supposition is very natural, the Philosophers have probably acquiesced in it, without judging it necessary to make any deeper Enquiries into this Subject. *But this is a noble Instance of Difficulties that do not occur at first Sight, but are only discovered by Reflecting, and which costs sometimes as much to find, as even the Solution of any other Difficulty.*

If the Air could pass thro' the Pores of the Skin with Sweatings and Vapours, Monsieur Mery asks why it does not likewise exhale, when one has shut it up in some great Tube of a *Vein* or *Artery*, in the *Heart* or in the *Stomach*?

And farther, why Animals should swell *in vacuo*? Affuredly 'tis the Air shut up in their Bodies and delivered from the weight of an External Pressure, which being rarified, makes them swell, and yet that Air should pass out more freely than ever thro' the Pores of their Skin.

'Tis true, there are some Animals that cast out the Air *in vacuo*, but then Monsieur Mery denies that it is by the Pores of the Skin; for instance, Air comes out of living Fishes, but Monsieur Mery, by observing that Fact very nicely, discovered that it came from under the Scales, where there must have been little Receptacles that were not yet known to us; and in effect, the Bodies of Fishes do not *unswell* for having render'd all this Air.

It is plain then, that the Air does not come out by the Pores of the Skin; it must be therefore, that coming with the Blood to the Extremities of the Arteries, it enters with it into the little Mouths of the Veins, follows it all the rest of the Circulation

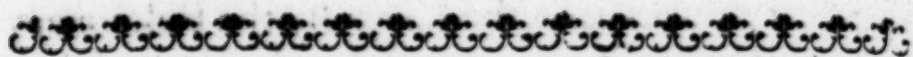
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tion, and goes into the Ventricle of the Heart, from whence it returns into the Liver by the Pulmonary Artery, whereas it came into it by the Veins. From these Arteries it re-enters into the little Vessels of the Liver, and goes out at last by the *Trachea* which brought it in, at first; this Course is not only proved by the necessity of Reasoning, but likewise by Experience, and by Blowing.

If one considers final Causes, and if one dares guess at the Intention of Nature, the Air is not less necessary to the Blood of the Veins, than it is to that of the Arteries; it even appears to be more so, the Veins have hardly any Elasticity or Springiness in comparison of the Arteries, and yet they contain almost half as much more Blood, and consequently they have still more need of a Foreign Strength to help on with its Motion.

The Air being weaken'd, and in some manner worn out by its Circulating throughout the whole Body, has nothing more to do afterwards, but to get out, and to give place to a new and more vigorous Air.





Upon SUBTERRANEAN FIRES, EARTH-
QUAKES, THUNDER, &c. Explained
Chymically.

THE best way to explain Nature, if it could be often made use of, is to ape or counterfeit her, and to give Representations of her, by making Causes that are known by us to produce the same Effects; then we should no longer guess, we should see with our own Eyes, and we should be sure that the Natural Phenomena do arise from the same Causes as the Artificial, or at least from Causes very near a-kin to them.

Thus Monsieur Lemery made an *Ætna, Vesuvius*, or Burning-Mountain, have inclosed in the Earth about a Foot deep, in Summer time, 50 Pounds of a mixture of equal Parts of the filings of Iron and of Sulphur pulverised, the whole being made into a Past with Water; at the end of 8 or 9 Hours the Earth swelled and opened a little in some places, out of which proceeded hot Sulphry Vapours, and afterwards Flames.

It is very easie to conceive that a larger Quantity of this Mixture of Iron and Sulphur with a greater Depth of Earth was all that was wanting to make a real Mount *Ætna*; that then the Sulphurous Vapours making their way out would have caused an *Earthquake*, more or less violent in Proportion to their Strength, and to the Obstacles they would have

have met with in their way; that when they had found or forced an Opening, they would have rushed out with an Impetuosity great enough to produce a *Hurricane*; that if they had broke out from any Part of the Earth lying under the Sea, they would have made those Spouts or Columns of Water so dreadful to Ships, and finally if they had risen up as high as the Clouds, they would have carried their Sulphur thither, and turned it into Thunder and Lightning.

It ought not to appear strange that this Sulphur plunged into the Water of the Clouds, does notwithstanding take Fire. The Sulphurous Matters do not naturally mix with Water, but if they are very much exalted, they will burn in it, witness what we call the *Gregeois* Fire. It is true nevertheless, that there is always some part of this Sulphur which is extinguished, and even with Explosion or Noise.

On the other hand, those Parts of it that burn in the Water make an Effort to free themselves, and to ascend, and this Effort likewise produces a violent Noise. This Monsieur *Lemery* proves by a new Experiment, where a Sulphurous Vapour rising from the bottom of a Marsh, being kindled by a Candle that was held in it, as it came out the Flame communicated it self nearer and nearer to all the Vapour that filled the void Space of the Marsh, gained the bottom, and caught a Sulphurous Matter that was in the Water, which Matter being inflamed, struck the Water violently to make its way, and so produced a little kind of Thunder. If the Flame does not reach to the bottom of the Marsh where the Sulphurous Matter is in the Water,
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the inflamed Vapour having nothing to fight with, makes no Fulmination.



Upon the Fecundity of PLANTS.

NONE of the Wonders that are obvious enough to the Eyes of all the World, and yet observed by few, is the Fruitfulness of Plants; not so much their natural Fruitfulness when left to themselves, as their artificial Fruitfulness, occasioned by Pruning and Cutting off some of their Parts. This artificial Fertility, is not really different from the natural; for in short, the skill of the Gardiner cannot communicate to Plants what they had not before; he only helps to Unfold and to bring to Light that which was actually in them. Monsieur *Dodart*, who enquires into this Matter, has not yet given us any Physical System, he only lays down Facts, but Reasonings and Calculations must establish them, because the Question is not so much what a Plant gives, as what it would give, if one drew from it all that it contains. Here follows an Example of the Fertility of one Tree in the Business of Seeds only, which are the last Term and Object of all the Productions of the Tree.

We know that all the *Branches* of the *Elm* are nothing but Bunches of Seeds very closely pressed together.

Monsieur *Dodart* having chose, at a venture, an *Elm* of 6 Inches in Diameter, and 20 Foot in Height

Heighth, from the Root to that Part where the Branches spring out, and which might be about 12 Years Old; he cut off one of the Branches of 8 Foot in Length, and flighting those Seeds that had been beaten out by the repeated Blows of the Hatchet, and others that were shed by the fall of the Branch, he only counted those that remained, and found upon that single Branch 16450 Seeds.

All the Branches that were not so long as 8 Foot taken together, made a Surface much more than double the Surface of 10 Branches of 8 Foot. But supposing them no more than double, because perhaps the lesser Branches are not so fruitful, all these Branches taken together would yield 329,000 Seeds.

An *Elm* may easily live 100 Years, and the Age of its middle Fertility is certainly not so little as that of 12 Years. You may reckon then for one Year of a middle Fertility above 329,000 Seeds, and put no more in the place of that Number, than 330,000, which is very little. But you must multiply those 330,000 by the 100 Years of the Life of the *Elm*, and that will amount to 33,000,000 of Seeds, which are the Production of an *Elm* for its whole Life, at the very lowest reckoning, and these 33 Millions come out of one single Seed.

This is one instance only of the Natural Fœcundity of a Tree, which has not disclosed all that is contained within it.

If it had been *Lopp'd*, it would have pushed out of its Trunk again as many Branches as it had in its natural State, and these new Sprigs would have come out in the space of 6 Lines of height, or thereabouts,

abouts at the Extremity of the Trunk that, was lopp'd.

In what part or at what heighth soever the Tree had been lopp'd, it would always have sprung out equally, which appears constantly by the Example of the Dwarf-Trees, that are cut almost level or even with the Earth.

The whole Trunk from the Ground up to that part where the Branches come out, is therefore quite full of Principles or little Embrio's of Branches, which indeed can never appear all at once, but which being conceived as divided by little Circular Rings of 6 Lines in Heighth, compose so many Rings, each of which in particular is ready to appear, and will really come forth as soon as the Lopping is made exactly above it.

All these invisible and conceal'd Branches do not less really exist than those that are disclosed; and if they did appear, they would likewise have an equal number of Seeds, which consequently they must already contain in little.

Wherefore, according to the Example proposed, there are in such an *Elm* as many times 33 Millions of Seeds, as 6 Lines are contained in the heighth of 20 Foot; that is to say, 1584,000000 of Seeds, and this Tree does actually contain within it wherewithal to multiply and re-produce it self such a surprizing number of times. *The Imagination is frighten'd to find it self carried so far by Reason.*

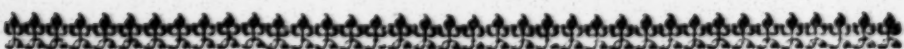
But what will it be then, if one comes to consider that each Seed of a Tree, does it self contain a second Tree, which also contains the same number of Seeds; that one can never arrive, neither at
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upon Circulation of the Blod in FISHES. 265

one Seed which contains no more Trees, nor at one Tree containing no more Seeds, or that has less than the foregoing; and that consequently there is an encreasing Geometrical Progression whereof the first Term is 1. the second 1584,00000000, the third the Square of 1584,00000000, the fourth its Cube, and so on in *Infinitem*?

Our Reason and Imagination are equally lost and swallowed up in this immense Calculation, and what one may call in some manner more than immense.

We shall find that Monsieur Dodart to avoid the Affectation of *Wonderful*, or perhaps to affect it more insensibly, has in respect of some Articles made his Calculations of the Fœcundity of Trees lower than they ought to be, but that Difference is of small importance. A Calculation, which in the utmost rigour would be too strong for the *Elm*, would be much too weak for the *Fern*, which is incomparably more Fruitful in Seeds; and in short, *let a Man be as sparing as he will in his Calculations, he will always arrive at Prodigious Numbers, and at Miracles in Natural Philisophy.*



Upon the Circulation of the Blood in FISHES.



Perhaps it can never be better proved than by the Subject of this Discourse, that Nature having laid down a certain general Plan, knows afterwards how to diversifie it in all the different Manners that the particular Applications require.

Air

Air is necessary to all kinds of Animals, we take that Truth for granted ; they do all therefore take in Air. But there are some whose Blood is naturally more brisk and fluid ; it is sufficient for that sort of Blood to go and take the Air in a certain Receptacle, called the Lungs, and from thence dilate it self throughout the whole Body, with the Air wherewith it is impregnated. There are other Animals, whose Blood and all their Humours, are so gross and glutinous, that the Air taken into the common Receptacle, and from thence distributed into the rest of the Vessels, would not sufficiently animate them ; it is therefore necessary that they be immediately impregnated with Air. Such Animals are the Insects, in whom the Canals that convey the Air, that is to say, the *Trachea*'s reign from one extremity of the Body to the other, distributing their Branches every where, and in several Sorts ; they have even as many external Orifices scatter'd about the Body, by which they receive the Air, as there are Rings upon the particular Insect, which is the Cause that if those Creatures are rubb'd with Oyl they immediately die, the Conduits of Respiration being thereby obstructed. This is the first difference that there is in the manner of Animals receiving the Air.

If the Animals have Lungs, the general Idea of that Mechanism is, that the Blood being extremely divided, and thereby reduced to have a large Superficies, presents it self to the Air, which is also very much divided ; so that each minute Particle of the Blood, goes and takes its little Portion of Air. Thus in Men, in four footed Beasts, and in Birds, the Lungs are nothing but a heap of an
infinite

infinite number of very small Vessels or Bladders, that are swelled with Air, and each little Vesicle has its exceeding fine Blood-Vessels, where the Blood receives the Air through the very fine Membranes or Skins of those Vessels.

The Blood impregnated with Air is to be distributed through the whole Body, and it is the Heart alone that does the Office of Receiving and Discharging it. If the Animals are destined to a continual Action, as most part of them are, the Heart has two distinct Ventricles, one of which serves to receive the Blood, which by circulating has divested it self of the Air, and to send it back to the Lungs; the other to receive the Blood in its return from the Lungs, and to disperse it throughout the Body. Thus all the Blood that waters the Body is laden with Air; but if there be any Animals that are to pass a considerable Part of their Lives without any brisk Motion or Action, such as *Tortoises*, *Frogs*, *Serpents*, &c. their Hearts have either but one only Ventricle, or several that communicate with each other, which is in a manner the same thing; so that the Blood returning from the Lungs, and impregnated with Air, mingles it self with that which returns from the rest of the Body, and is divested of the Airy Particles, and consequently the Blood protruded by the Heart through all the Body, is less animated and lively.

These are all the Varieties of Respiration in Animals that breath Air; but Fishes, which live in Water, and which die almost as soon as they are carried into the Air, how do they respire? It is certain, and Monsieur *du Verney* has proved it, that
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this Air in which they die, is nevertheless absolutely necessary to their very Being.

There is always a great deal of Air mixed and involved in Water; 'tis that Air the Fishes breath. What we call their Gills, are their Lungs; and the whole Mechanism of the Gills has no other end but only to draw this Air enclosed in Water, and to present it to the Blood, after the same manner, as it is presented in the Lungs which receive it immediately.

Monsieur *du Verney* has studied and unravelled in the Gills of a Carp, this Mechanism almost infinite and prodigiously complicated.

The first Thing that offers it self, is a kind of Carpenter's Work, consisting of a very great number of bony *Lamina*, each of 'em sub-divided into an Infinity of bony Nets; the use of all which is only to sustain an innumerable Multitude of the Ramifications of an Artery that proceeds from the Heart. It is plain, that this surprizing Quantity of exceeding fine Ramifications serves to present the Blood extreamly sub-divided, and as we may say, each little Particle of Blood all alone. Among the *Lamina*, and in the whole Contexture of the Gills, there are an Infinity of narrow Intervals or Spaces destined to receive like Strainers, and to sub-divide into very small Particles the Water which the Fish respire by its Mouth. 'Tis then that the Air, to which in some manner, its Prisons are opened, makes its Escape from that Water, and goes and joyns it self to the Blood of all the little Arteries. As these Gills have necessarily an alternate Motion of Dilatation and Compression, which is still performed by other very nice Machines;

as they receive the Water when they dilate themselves, and expel it again when they are contracted : It is most probable that it is at the instant of the Compression, that they oblige the Air squeezed out of the Water to penetrate the Pores of the small Blood-vessels ; for that instant has more Strength than the other, and that Action requires more. This same Reason has place with respect to the Vesicular Lungs, such as those in Men ; and from thence Monsieur *du Verney* concludes, that altho' the Air comes into our Lungs at the Moment of Inspiration, it does not mix with the Blood, but at the Moment of Expiration, and when a superfluous remnant goes out by the *Trachea*. Thus the real Inspiration, that is to say, the Entrance of the Air into the Blood would become the Expiration.

*Carp*s, as well as several other Fishes, respire Water by the Mouth, and cast it out again by the Gills, after having extracted from it all the Air they can. Herein they differ from other Animals which receive and throw out the Air by the same Conduits. Because there is little Air in a great deal of Water, the Number of the small Arteries where the Blood divides it self, must be much greater in the Gills of Fishes than in the Vesicular Lungs of other Animals. On the other hand, the Air that is shut up in the Water is more confined there, its little *Spiral Laminae* are more compressed therein, than if it were mingled with other Air, consequently it has a greater Spring ; and as it is in proportion to its Spring, that it gives Motion and Impulsion to the Blood, a smaller quantity may produce a sufficient effect in the Fishes.

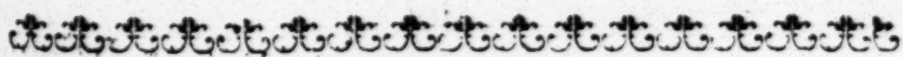
When they are in the Air they die, because the *Strainers* of their *Gills*, which are *Passes* narrow enough for the Water are not so for the Air; for that makes its Way too easily out of them, and can't be forced to enter into the little Arteries. These *Strainers* have no Power over the Liquor that percolates them without doing it Violence.

After that the Blood of the little Arteries in the *Gills* is laden with Air, it passes according to the Laws of Circulation into all the little Veins that answer the said Arteries; but that which is very singular is, that according to the Observation of *Monf. du Verney*, the Veins of the *Gills* being once gone out of them do presently become Arteries, and expand themselves into all the Parts of the Body, from whence other real Veins bring back the Blood to the Heart.

This Metamorphoses of Veins into Arteries, appears by several Tokens. 1. The Heart has but one Ventricle, and one Artery which goes ramifying it self, and is lost in the *Gills*. What Canals shall water the rest of the Body, and carry into it the Blood vivify'd by the mixture of the Air? 2. The Veins of the *Gills*, which are nothing but an Infinity of exceeding small and fine Ramifications, carry their Liquor when they go out of the *Gills* into Trunks that are much bigger, and these large Trunks, being dispersed thro' the rest of the Body, do again sub-divide themselves into little capillary Branches, which would not happen to Veins that were to continue Veins; for they would end by the largest Trunks, as the Arteries do by the smallest Ramifications. 3. At the coming out of the *Gills*, where *Monf. du Verney* pretends

tends that these Trunks which receive the Blood of the Veins become Arteries, they do effectively take the consistence of Arteries, and have Tunicks or Membranes more strong and solid than those of Veins.

The general Plan of Nature, which has order'd that the Blood of a whole kind of Animals should be mingled with the Air in a common Receptacle, does again divide it self into two Branches. The Blood which has passed by this Receptacle does either return to the Heart, that disperses it again through all the Body, or distributes it self immediately therein, as it goes out of the Receptacle of the Air. Perhaps this last Mechanism was necessary for the Fishes, because their Blood takes little Air, and that the Impulsion it receives from thence would become too weak if it were obliged to resume the Circuit of the Heart. If our Notions are true, what a wonderful Variety of Mechanism is there with respect to our different Wants? And if other Subjects require the same Variety, it will doubtless be still more marvellous with respect to real Wants, than to such as we may have falsely conceived.



A Second Philosophical Dissertation upon the Fecundity of PLANTS. [Vid. p. 262.]

IN the History of the Academy for the Year 1700, you have an account of the Experiments upon which Mons. *Dodart* had establish'd the prodigious Fecundity of Plants: He did there confine himself chiefly

to Matters of Fact, having scarce meddled with the Physical System thereof; now he proceeds Systematically.

A Tree that has been lopp'd, and shoots out new Branches, from whence does it fetch them? *Mont. Dodart* proves, and the thing seems of it self extremely probable, that neither the Trunk of the Tree, which is no more than a Packet of Fibres, or a Heap of Tubes void of all Action, nor the Sap, which like the Blood is destined to nourish, but not to form the Parts, can produce these new Branches; that consequently they must have existed before the lopping of the Tree, but in little, and shut up in invisible Buds.

If one had not lopp'd the Tree, the Sap would have continued its course in the Branches already formed and shot forth, and would not have endeavour'd to have unfolded those that were in the Buds.

If the Body of the Tree had been cut in any other Place, new Branches would have appeared after the same manner: Consequently some Buds are there likewise, and do inclose little Branches which the Sap might unfold.

The Body of a Tree may be cut in an Infinity of different places, and all the Wounds will afford new Branches. Such a Body does therefore contain an Infinity of Buds involved in little Branches; But they are not all unfolded, either because there is never a sufficient quantity of Sap in one only Tree, to bring forth all the Parts that are contained in it; or else because those Buds at their shooting out hurt one another by their excessive Numbers, and that only those which are towards the external

terminal Parts of the Tree, have the Liberty of exerting themselves, because they want the help of the Air for their Vegetation:

These two last Causes joyned to the Motion of the Sap, which must be shot up almost in a streight Line from the bottom to the top, may give us to understand why the principal Production of the Branches is made at the top of the Tree, and why, when the Tree is lopp'd, there are none but the little Buds placed by Nature in those Parts that are cut, that have any Advantage thereby.

An Animal that is contained in its Egg, being once disclosed and hatched, is entirely so; if he loses any Members, he loses them irrecoverably, having no reserve, tho' he should want it never so much. But a Plant does never discover all that it contains, and has hidden Riches with which it can repair its Losses, and often with advantage too.

A Bud contains the Branch with its Leaves, its Fruit, its Seed, and all that actually existing, and even visible too very often, as soon as the Bud begins to unfold it self.

As the Consequence may frighten Mens minds, *Monf. Dodart* forgets nothing to render it necessary by making good the Principle that produces it: Then he endeavours to render it receivable by it self, and to accustom us to the Idea of Infinite: This would be no difficult matter with those that have been used to dig in Physicks or Mathematicks: They know they can't go far without meeting quickly something of Infinite: *as if the Author of Nature, and of all Truths, had taken care to*

stamp all things with his chief Character. But it is certain, that this Notion does at first always shock common Imaginations.

*Upon the Effects of the Spring of the Air in
GUNPOWDER, and in THUNDER.*

THE Air, which till these latter times, seem to be nothing else but a liquid Matter, almost wholly incapable of Action, is now discover'd to be one of the most universal and most violent Agents that there is in Nature. The Strength of Gunpowder for Example, so amazing even to Philosophers themselves, is nothing but the Power of the Air. There is Air shut up, or rather closely imprison'd in every Grain of Gunpowder. There is likewise Air filling all the Interstices between every single Grain, and when the Powder is set on Fire, the Springs of all these little Masses of Air are dilated and loosen'd all together. These Springs are the sole Cause of so many prodigious Effects; for the Powder serves only to kindle a Fire that puts the Air in action; after which, 'tis the Air alone that is the Soul of all.

Monf. de la Hire is therefore of Opinion, that all the Phenomena of Gunpowder are to be attributed to the Properties of this Elasticity or Springiness: Here follow the principal, or at least those that have been the most necessary to him in his Enquiry.

A Spring bent, tends to unbend it self on the two opposite Sides with equal Violence. A Spring requires a certain Resistance to exercise all its Strength, and it is the less active by how much the more the Body against which it acts, yields to it, or flies from it. A Spring produces a more sensible Effect on one Side, when it meets with resistance on the opposite Side.

Upon these Suppositions, *Monf. de la Hire* considers all the Springs of the Air put in action by the Fire which kindles the Powder shut up in the Body of a Cannon: Some Philosophers have thought that when the Powder was kindled successively, its Effort was greatest at the place where it began to be inflamed, because its force was augmented by that which was kindled afterwards. But tho' this reason may be specious, it is not true; for according to the Reflection of *Monsieur de la Hire*, a Spring supported against another equal Spring which resists it, has all the Strength it can have; and it will not have more, tho' other Springs do succeed one another to support it, or to support those that do support it. On the contrary, perhaps the Force of the first will be lessened whilst the others shall be put in motion; and if in that space of time the Body, against which they are to act, begins to yield, their Actions will be so much the weaker.

It is therefore better that the Springs should be loosen'd or unbent all together, even when one would not make them act but at the place where the Powder began at first to be kindled. It is moreover certain that the Powder being kindled all at once, a greater Heat puts the Springs into a greater Tension,

Tension, and as they all are supported mutually at the same time, they are capable of a greater effect towards all the Sides. The only Danger is, lest the Cannon should burst by a too brisk and sudden Inflammation of all the Powder, and it is found convenient to make it a little slower.

The Cannon being thick enough to resist all the Impulsions that are made from the Axis of the Cylinder of its Body towards the Circumference, there remains only those Impulsions that are made towards the Breech and towards the Mouth of the Cannon. The Springs push equally against those two opposite Ends, from whence it is, that the Cannon recoils, at the same time that the Bullet comes out of its Mouth. The same Force therefore that causes the Recoil, is that which causes the Motion of the Bullet. But from whence proceeds it, that the Motion of the Bullet has so great an Extent, and the Recoil so small a one? The reason is, the Cannon has much more Difficulty to move it self backwards, than the Bullet has to move forwards; and as the Force that produces these two Effects is equal, the Way which the Bullet makes does so much surpass the retrograde Motion of the Cannon, as the Difficulty it finds in going backwards exceeds that which the Bullet has in moving forwards.

There must therefore be a great Resistance to the Recoil of the Cannon, which is always very small, and in effect one perceives at first Sight that that Resistance is the Friction or Rubbing that is made against the Earth by so heavy a Machine as is a Cannon with its Carriage. But there is more in it yet; the Resistance to a Motion is so much

much the greater as the Motion is quicker, and when it is so, to such a Degree that that which resists has not time to yield, then a Body weak enough of it self may keep the Place of an immoveable Body, and of an invincible Obstacle. It is for this reason that both the Air and the Water, being struck with so much Swiftness, and with so quick a blow that they have not time to fly, become fixed Points, the one for the Motion of Birds, and the other for the Action of Oars. In like manner, if you hang a Stick by the two Ends to two fine Threads, and strike it in the middle with a very quick blow, you may break it there, and the Threads which support it will remain entire. The reason is, the Fibres of those Threads do require a longer time than is given 'em to extend and separate themselves, and the Air besides is not able to fly fast enough from under the Stick, which having been sustained on all sides by firm Supports, receives the entire Impression of the blow, and so is broken.

The extream Swiftness, or to speak more properly, the extream Suddenness of the Motion impressed by the Powder upon the Cannon, ought therefore still to increase the Resistance which it finds in recoiling, whether it be on the part of the Earth, or even on that of the Air, if a Cannon were suspended the Experiment shews that the Recoil would be very great.

A Sky-Rocket, the Construction of which, I suppose, is well known, is no other than a little very light Cannon; which by the Effort of the inflamed matter contained in it, recoils in the Air with as much Swiftness as the inflamed matter has
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to come out of the Orifice, which is turned downwards. 'Tis by this Recoil that the Rocket flies upwards.

The Rocket being filled with all that Matter which belongs to it, if its Centre of Gravity were above the Centre of its Figure, with respect to that End that is closed, which is that that goes foremost, it would happen, for the Reasons mention'd in the History of 1700, that as soon as the Rocket begins to raise it self, it would make a Semi-circle in the Air, and be turned upside down; after which it would redescend, because the closed End of it, which makes the Recoil, would be turned towards the Earth. Wherefore, as it is impossible in the Practice to determine certainly the Centre of Gravity and its Position with respect to the Centre of Figure, there is a much shorter and easier Expedient made use of: They fasten to one of the sides of the Rocket a Stick, the weight of which is such, that the Centre of Gravity of the Rocket and Stick altogether are a little below the Orifice of the Rocket. If this Centre is below the Orifice or Mouth when the Rocket is filled, it is yet more so when it flies upwards, and when by discharging the matter it contained it becomes still more light. This Centre therefore changes and descends continually in Proportion as the Rocket rises, and consequently makes it keep a straight Motion.

Monsieur *de la Hire* owns, for the Glory of those course and uncertain Experiments which have produced Arts, that he thinks that the nicest Speculation could have added nothing to the Construction of these Rockets; only he observes, that the

Stick

Stick being fastened to one of the Sides, the Centre of Gravity of the whole together can't be in the Axis of the Rocket, that consequently it can never raise it self up very vertically, and that in order to give it such a Direction exactly, it were better to fasten a Stick to each Side, the weight of both which Sticks should not exceed that of the single one.

It is easie to apply to Petarero's the same Principles which we see acting in Cannons and in Rockets. Monsieur *de la Hire* proposes, that in order to augment the Effect of a Petarero against a Gate, or against a Wall to which it was fastened, it should be so fixed and planted as to become, if possible, immoveable on the opposite side, thereby its recoil would be prevented and its Force redoubled on the side on which it is to act.

Thunder it self is no other than a kind of inflamed Gunpowder; and Men may boast, without any Presumption, that they can imitate it. It is a Composition of Sulphur, of Salt-Petre, or some other Substances very like them, and the Air being put into Motion by their Inflammation, makes the chief Phenomena of Thunder.

If this Air when it dilates and unbends it self meets with no Resistance, we then see the Lightning but hear no Noise. If it meets with Clouds which oppose its Motion, there results from thence that Collision of the Air which causes the Noise, and this Noise is so much the louder as the Clouds composed of small Particles of Ice, are less proper to receive Motion from a very much inflamed Air. When the Fire of Thunder moves with so great a Violence, it bends and compresses the Springs of the thick Air wherewith it is surrounded, that Air does thereby

thereby become capable of resisting it, and of driving it backwards; which happening several times following makes the Lightning appear like streaks of broken Fire.

The Air which is nearest the Earth being thickest and coarsest, is that which must have the greatest Strength to resist the Motion of Thunder, that is to say, to make it re-mount, and consequently it must happen pretty often that that Flame being repulsed towards the place from whence it came, is dissipated without producing any Effect.

We see sometimes Water rising out of a Tube, mount 3 or 4 times higher than the depth of the Basen or Fountain allows, and so it is soon reduced to that heighth which the Laws of Hydrostatics prescribe it. But how could it go out of it in an instant? *Monsieur de la Hire* attributes it to some Air shut up in the Conduit, which having been pressed and put into Motion by the Water continually descending, discharged it self against that which ascended, and communicated to it this momentaneous Swiftnefs. So he believes the Violence of Thunder may be sometimes augmented by the Air, which after a strong Compression, occasioned by the Fire of Thunder it self, resumes its natural Extension. *It is impossible to follow all the Effects of the Air, it is almost it self alone the Soul of the World, if we understand by the World, that which we inhabit, and which is nearest to us.*

Upon

Upon the Experiments made by a Convex
BURNING GLASS.

Hitherto Chymistry has not employed in the Decomposition or Dissolution of Bodies any other Agent more proper for that purpose than Fire. Fire has been its universal Dissolvent, or almost always the Soul of its other Dissolvents; and we have not otherways been able to Discover the nature of Compound Bodies, but only so far as we could unravel their Contexture, and unfold their Principles.

It is not that Men had not already bethought themselves of using another Fire, incomparably more active than the Culinary, that is to say, the Rays of the Sun reunited by the Burning-Glass; but they knew no other excepting those Glasses that were Concave, and of Metal, and which burnt by Reflexion; and for as much as it is necessary that the Burning-Glass, to make the Focus the smaller, and consequently more vigorous, should be exactly parallel with the Disk of the Sun, the Rays which came perpendicularly, that is from Top to Bottom could not be otherwise reflected, but perpendicularly again, that is to say, from the Bottom to the Top, and the Vessels into which they put the Solid Matters, in order to melt them, being necessarily in a reversed Situation, those Matters ran out upon the Ground as soon as they felt the Sun, so that Men could make no followed nor lasting Experiment, and

and the Burning-Glass became thereby a Curiosity almost entirely useless.

It was therefore necessary that the Glasses should be Convex, and burn by Refraction, because then the Rays would always descend perpendicularly, and the Matter in which they were to be used would be in a convenient Situation. But for great Focus's, such as those that were wanted, great Glasses were required; and besides the Difficulty of cutting such great ones, since one can hardly reach those that are necessary for great Telescopes, which have but some inches of Diameter, there still remains still the Difficulty of melting a sufficient Quantity of Glass without breaking it as it came out of the Oven, or as it cooled.

We have seen in the Histories of 1699, and 1700, that Monsieur *Tschirnhaus*, Associate Academicist, had found out the Art of making Glasses Convex of 3 or 4 Foot in Diameter, which is an extraordinary Thickness, and the Effects that it produced are there related.

The Duke of Orleans sent for one of those great Glasses of Monsieur *Tschirnhaus's* from Germany, placed it in the Garden of the Royal Palace, and has had the Goodness to allow the use of it to the Academy, who can't use it with more understanding than his Royal Highness himself.

Monsieur *Homburg*, whose Patron that Prince is, has taken the Advantage of using that Glass as much as he could: But one would scarce believe perhaps that during all the Summer of this Year 1702, he could meet with but 8 Days that were entirely favourable, in which the Sun shined out clear from 9 or 10 in the Morning, to 3 or 4 in the Afternoon.

He

He began with the Trial of Metals, and particularly with that of Gold.

Gold, let it be as well refined as possible, being put to the Focus crackles and throws out an infinity of very small Drops to the distance of 7 or 8 Inches, which being catched upon Paper and beaten, make a Powder of real Gold; so that all their alteration consists in the minute Division of them.

Let the Gold be a little farther removed from the exact place of the Focus, and it will presently smoak, and almost as soon a good part of it be turned into Glass, of a deep Violet Colour; and if you please, all that is not evaporated in Smoak shall be vitrified. This Golden Glass weighs less than the Gold it self.

If you remove it farther from the Focus, it will only smoak, and that which is lost of it will be lost very slowly. It would even fix it self, if care were not taken now and then to bring it nearer to the Focus.

It appears plainly, and at first sight, by these Phenomena, that Gold is not fixed, since the Heat of the Sun makes it evaporate; and that it is only so with respect to the more gross and unactive Fire of the Laboratories. It appears moreover, that by the Sun's Heat it is absolutely decomposed, and its first Principles separated, since one Part of its Substance is exhaled in Smoak, and the other, which must be very different, is turned into Glass. But that you may better understand this Effect you ought to be informed exactly of the Nature of Vitrification.

Glass is composed of a very fine and good Sand, and of the fixed Salts of Plants, which are put
T
together

together over a great Fire. These Salts being violently agitated by the Heat, and not being able to evaporate by reason of their Fixedness, penetrate on all sides the Sand or Earth wherewith they are mingled, dividing and sub-dividing it after such a manner, that there does not remain, as one may say, two Atoms of earthy Matter which has not been separated by one Atom of Salt. From thence proceeds at the same time, both the Fragility and the Transparency of Glafs; which in the smallest Parts of it is composed of heterogeneous and dissimilar Particles, which consequently are not much united together, and the Intervals or Spaces of which always admit Light. All Vitriification therefore results from an Earth, which being exposed to a great Heat, has been intimately penetrated by some other Body that melts it.

Now if we suppose that the Principles of Gold are Mercury, a metallick Sulphur, and an Earth, the whole will be easily explained. The Mercury which is volatile, is that which is exhaled in Smoak. There remains the Earth and the Sulphur which are fixed; the Sulphur is that which puts the Earth into Fusion and vitrifies it. The Glafs of Gold is less heavy than the Gold it self; for that which is most weighty in Gold is its Mercury, which does not enter into the Formation of the Glafs. But how comes it that Mercury, which is the most heavy Principle, should be volatile, whilst the other two, tho' lighter, are fixed? The Reason is, because Mercury is not volatile, but on account of the extream Facility with which it is divided into Parts indefinitely small. Thus Water, tho' more heavy than Air, rises up into it when it is reduced into Vapours.

Other

Other Experiments support this System. If Silver refined by Lead be exposed to the Sun, there will be formed upon its Surface a pretty thick Powder, which does not vitrifie; but if you take Silver that has been refined by Antimony, the Powder of that will be vitrified. The reason is, because Silver has of it self too little Sulphur in proportion to the Quantity of its Earth; but when it passes through the Antimony it retains the Sulphur thereof, which augments the Quantity and Strength of its own.*

After these Explanations, we shall not be surprized, if Gold that has been melted in the Sun, and suffer'd to fix, be afterwards more difficultly dissolved by the Spirit of Salt, the common Dissolvent of this Metal, and if it be dissolved without any sensible Ebullition; we presently conceive that Gold having been melted in the Sun, and by consequence infinitely divided into all its little Molecules or Atoms of Gold, these Atoms when their Motion ceases are united, and more closely pressed together than before, and consequently have smaller Pores, which receive more difficultly the Points of the acid Dissolvent. At the same time, those Pores being smaller, contain less of the aërial and foreign Matter. Now the Ebullition which is made in the melting of any Metal, does only proceed from such aërial Matter, of which the Springs and the Spires are dilated when its Prisons are open'd.

Monsieur *Homborg* maintains, that our Culinary Fire is nothing else but a Mixture of that infinitely subtil Matter which makes Light, and of a course Oil drawn from Wood or any other Materials that

are used for Fuel. The Fire of the Sun, is nothing else but the pure unmixed Matter of Light, and how great must the difference be between the Activity and between the Effects of one and the other, between a Chymistry that has as yet made use only of the first sort, and that which is assisted by the latter? *We may expect, without being too presumptuous, a Sett of Physicks almost New, since we have found out a new Key to let our selves into the internal Composition of Bodies.*



*Upon the Perpendicularity of the Bodies of TREES
and PLANTS, with respect to the Horizon.*

IF it be remembred that the Perpendicularity of the Bodies of Plants, in relation to the Earth from whence they Spring, or, which is the same thing, with respect to the Horizon, has been counted wonderful in our History of 1700, it will be easie to joyn the following Observation to what Mons. Dodart reported before upon that Subject.

The same Gentleman saw, in the Month of December, a heap of Acorns upon the Ground, which had been trod under the feet of Passengers; several of those Acorns had put out, but none of 'em had taken root. All those *Germes* are nothing but the Roots of the growing Plant, and they sprang out of the Centre of the pointed part of the Acorn, and were from 4 to 18 or 20 Lines in length. In a word, all these *Germes* or little Roots crept along seeking the Earth; and as there was none of 'em which

by

by the chance of their Situation were directly turned towards the Ground, they made all of 'em such Turnings and Windings as were necessary to get thither by the shortest way, or perpendicularly.

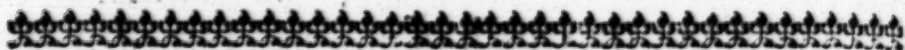
Monf. *Dodart* observed particularly one Acorn that had the Centre of its Point turned directly upwards or towards the Zenith, and the Root which came out of it, after having followed that Direction for about the length of an Inch, turned short of it self, that it might incline towards the Earth.

This put Monf. *Dodart* upon the Thoughts of planting six of those Acorns in a Flower-Pot, the point of their Root as directly upwards as he could, to see what would come of it ; and he cover'd 'em with two good Fingers breadth of Earth moderately crushed down.

About two Months afterwards he dug them up, and found that all the Roots had made a *Cross* or *Elbow*, that they might turn downwards ; as if they had been sensible of the Trick that was put upon them.

According to the Conjecture proposed by Monsieur *Dodart* in the History of 1700, which is, *that the Vapours of the Earth contract the Fibres of the Roots, and thereby draw them towards the Earth* ; this Fact would be inexplicable, supposing that the Acorns had been planted very exactly and geometrically with their Points upwards. For in that case the Vapours not being able to affect one side, or one part of the Root more than the other, they could not contract the Fibres thereof on any side ; and consequently they must leave to the Root its first Direction upwards. But it is probable, that this Geometrical Exactness was not, and even could

not be observed in planting the Acorns, so that as soon as the little Root inclined towards the Earth more on the one side than on the other, the Vapours presently found out that weak Part, and there applied themselves to contract the Fibres, and by that means to draw the whole Root downwards.



Upon the Origin of RIVERS.

 Onfieur *Mariotte*, and Monsieur *Perrault*, a Brother of him who has been one of the most Worthy Members of the Academy of Sciences, have referr'd the Origin of *Fountains* and *Rivers* to *Rain*.

Those Gentlemen pretend that the Rains penetrate the Earth 'till they meet with the Clayey Parts of it, which are solid enough to sustain and stop them, and that they glide and run along the Bottoms of such Earth, on the Sides that are most inclined or steepest, 'till they meet with an Opening, by which they escape; that is what we call a *Spring*. If we calculate the quantity of *Rain* or *Snow* that falls in a Year upon all that Earth which is to furnish, for instance, the Water of the *Seine*, we shall find that the *Seine* does not require above the 6th part thereof, which allows the Authors of this System room enough. As for the Continuity of the running of Rivers, it proceeds from the slow manner in which the Rains penetrate the Earth, which are a long time in gathering themselves upon the Bottoms that contain them
after

after they are fallen. Moreover, when the Rivers are very large and deep, they overflow the Lands a great way beyond their Banks, with the Waters which re-descend afterwards into those same Rivers, as they become lower; but their Descent is slow, and consequently contributes towards feeding them in spite of the long Droughts. The Birth of these Springs is ordinarily at the foot of Mountains, because the Mountains collect the largest Quantities of Water, and give 'em a greater Inclination towards one and the same Side; and if we sometimes meet with Springs in high places, and even at the tops of Mountains, they must needs descend from places that are yet higher, and be carried along Beds of Clay, as if it were by natural Channels. But if between one Mountain, from the top of which there comes a Spring, and a Mountain yet higher, which is to supply the Water of it, there should be a little Valley; you must imagine that Spring to be like a Water, which from a Receptacle of a certain Depth, has been carried by Subterraneous Pipes, and is come to make a Jet or Cascade of a Height equal to that of the Receptacle, or less.

Monfieur *de la Hire* examined this System at the most essential Part, where Authors likewise seem to be least upon their Guard. He had a Mind to try by Experiments, whether the Waters of Rain or Snow could penetrate into the Earth as far as the *Tuff*, or as far as the Claiey parts, and he found they did not penetrate at the depth of 16 Inches in a sufficient Quantity to form the least Collection of Water upon a solid Bottom; besides, it was necessary that the Earth upon which he made

his Experiment should be entirely divested of Grass and Plants ; for where there was any, and they become a little strong, the Rain was so far from being sufficient to collect it self below the Depth of 16 Inches, that it did not suffice even for the Nourishment of such Grass or Plants, and they were forced to water them besides from time to time.

This Observation excited *Monf. de la Hire* to examine more nicely into the quantity of Water consumed by Plants. In the Month of *June*, he put into a little Viol, in which there was one Pound of Water exactly weighed, two Leaves of a Fig-tree of a middling Size, and which weighed together five Drachms and 48 Grains ; the Stalks of the Leaves were within the Water, and the Neck of the Bottle was very well stopped. He exposed the whole to the Sun and Wind, and in the space of five Hours and a half, the Water in the Viol was diminish'd two Drachms, that is to say, one 64th part, which the two Leaves had drawn, and the Sun and the Air afterwards caused to evaporate. As the freshness of the Leaves is not maintained, at least in the day-time and during the Heat, but by the continual Passage which they give the Water that ascends from the Roots, and is afterwards dissipated, those two Leaves if they had been growing on the Tree, must have drawn from the Earth in five Hours and a half, the two Drachms of Water to preserve themselves in the same state of freshness. One may judge from thence how much the whole Fig-tree drew in one Day ; and consequently, what a prodigious Quantity of Water is spent in the Nourishment of Plants.

it is probably for this reason that the Rains do most abound in Summer; and that the three Months of *June, July and August*, do commonly furnish as much thereof as all the rest of the Year. It appears by the Experiment of *Monf. de la Hire*, that the Rains alone, even in that Season, would not suffice for the support of the Plants: for the Moisture of the Earth, the Dews, Mists and Fogs, do very much contribute thereto, how then could the Rains only produce Rivers?

The Observation of *Monf. de la Hire* upon the Depth to which Rain-water can penetrate, was made upon a middling sort of Earth, between Sand and Clay; and which consequently did not much resist the Water: If the Earth were only Sandy, it is certain the Water would penetrate much deeper, and then, provided that all the other Circumstances were favourable, a River or a Fountain might proceed from the Rains, and without doubt it does so happen in some places; but this Origin is not the most general.

For Example, How can this agree with the Water of *Rungis* near *Paris*? There is 50 Inches of Water always running; all the Earth that could furnish it, does not receive a Quantity of Water equal to those 50 Inches, if you compute it according to their continual running; and besides, the greatest part of the Rain-waters do either evaporate after they are fallen, or feed the Plants, in a Country that is much cultivated. It is true, the Water there is shallow enough, but its Depth does considerably exceed 16 Inches. The Country is high, and such is its Disposition, that to bring the Waters from some places yet higher, one must
suppose

suppose that there are natural Pipes, such as those that are made use of to throw Water artificially, and that they do descend and ascend after the same manner; an Hypothesis pretty hard to be conceived; for besides that, this Disposition of the Pipes and Aqueducts is too exact and regular to be natural, how happens it that it should never fail by any Cleft or Crevace?

Wherefore, for the Explanation of these Kinds of Springs, other Philosophers have fancied Subterraneous and Concave Rocks, which like Alembicks receiving from the bottom of the Earth watry Vapours, might condense them by their Coldness, and reduce them to Water again. But *Monf. de la Hire* observes, that this System can't be applied to the Waters of *Rungis*; for he caused several Pits to be made thereabouts, but could find no Rocks; and consequently those Waters were not collected by such subterraneous Alembicks.

What remains then? *Monf. de la Hire* inclines most to this last System, but allows not of the Necessity of Alembicks. There may be under Ground, and upon a Level with the Sea, great Receptacles of Water, from whence the Heat of the bottom of the Earth will raise Vapours, which being come towards the Surface, will be condensed by the Cold they meet there; after which they will run upon the first Bed of Clay they can find, 'till an opening throws them out of the Bosom of the Earth. But these Vapours when they have resumed their first Nature of Water, can't fall down again by the same Conduits by which they ascended when they were Vapours; and tho' that could be conceived, yet it is nevertheless a
Difficulty

Difficulty, and a kind of begging the Question in this System.

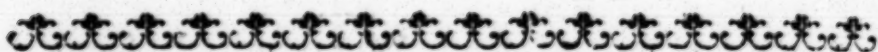
Monfieur *de la Hire* has, notwithstanding, improved the fame by a new Notion: He fupposes that the Salts in Stones may ftop and fix the Vapours, and thereby contribute to the changing them into Water again; and we fhall fee that an Experiment, which he has not carried fo far as he intended, favours that Notion.

The Fountains of fresh Water which feem to have a Flux and Reflux like the Sea, and which nevertheless do not come from it, becaufe their Waters are fresh, do naturally enter into the Hypothesis of Monf. *de la Hire*. When the Sea afcends, it compreffes the Air inclofed in the Cavities that contain the Subterraneous Waters, and the Air thus compreffed obliges them to fly out by fome Orifices, which we fee commonly perform'd by feveral Machines. As for thofe Fountains, which only flow by Intervals, and at certain Hours of the Day, they proceed from fome Snows upon which the Sun does not fhine at thofe Times, and which ceafe melting when that is withdrawn.

By thefe two Examples it will be eafy to folve the Caufes of extraordinary Fountains, as foon as we can be informed of the particular Circumftances of them; the greateft Difficulty is to come at good Accounts, and fuch as are thoroughly purged from thofe falfe Miracles which popular Traditions are always adding.

From this general Theory Monfieur *de la Hire*, defcends to particular Remarks upon the ufe of Rain, and Spring-water, and that contained in Cifterns. He takes notice of an Accident new enough, of
some

some Rain-water kept in the Observatory, and which smelled very much of the Smoak, the reason of which was, the Observatory stands on the South-side of *Paris*, and that Rain fell with a North Wind, which drove the Smoak of the Chimneys upon the Observatory, and mingled the Particles thereof with the Rain.



Upon the Manner in which several BODIES are turned.



T is not only our Understanding that is at a Fault in discovering natural Causes, but it seems likewise that our very Eyes are deficient in observing the Effects, and a thousand things do continually offer themselves to our View, without being taken notice of.

How few are they that know that the *Shells* of *Snails*, which are *Helixes* turned about a sort of a Cone, are all turned after the same manner in the same Kind, and, which is yet more considerable, after the same manner, in almost all the Kinds? The manner of turning is from the Left to the Right, if you view the Shells from the sharp end upwards. Monsieur *Parent*, after several Enquiries into all the Snails of the Land, of the River, of the Sea, and even of the Stones, could meet with but three Kinds in which the Shells are turned from the Right to the Left.

He has carried this Observation as far as the Plants, of which there are a great number that have

have either their Stalks, or their Flowers, or their Cods, turned after a certain manner; others, whose Flowers or Seeds run along about the Body of the Plant like a Helix, and consequently fasten themselves thereto in a determinate manner, which manner is always the same in the same kind; and moreover Monsieur *Parent* having made the most ample Reckoning he was able of the different Kinds with respect to these sorts of Peculiarities, he always found that one certain manner was predominant, that is to say, for instance, that in 33 kinds of Plants that had their Stalks turned to the Right, there were but four turned otherwise; and that in 15 kinds the Cods or shells were turned to the Left, and in two only to the Right.

Monsieur *Parent* has likewise observed, that the Fibres of a Heart of a Man, are always turned in the same manner, the External from the Right to the Left descending, and the Internal after the same manner ascending; and that on the contrary, the *Tuff*, which the growing Hairs form on the Top of the Head, is almost always turned from the Left to the Right with respect to him that wears them.

It is sufficient to have said, that upon these kinds of Subjects that are so rarely taken notice of, Observations may be made, and that one may turn ones Eyes and Thoughts that way. Every Body will afterwards find enow of the like Occasions in contemplating Nature.

The constant and invariable Determination of some Parts, whether it be of a Plant, or whether it be of an Animal, to be turned after one and the same manner, does assuredly proceed from the Grain
or

or the Egg, and this is a new Proof that Generation is nothing but an Unfolding: *But who has fixed this Determination in the Egg, or in the Seed?*

The same Question might be started upon the same manner in which Planets turn, and all may be referr'd to the first and purely arbitrary Will of Him that made the World. But another Question, to which one seems obliged to answer, by the Concatenation of second Causes, is to know, why a greater Number, either of Plants or Shells, are turned after one certain manner?

Monfieur *Parent* conjectures, that this may have some Affinity with the System of the Loadstone. He believes that we may allow of two Vortexes, or Whirlpools, of magnetick Matter turning in the Figure of a *Helix* about the Earth, and the length of its Axis, in two ways opposite to each other, one of which comes out of one Hemisphere, and the other at the opposite Hemisphere. This magnetick Matter is subtle enough to penetrate Bodies, and consequently Eggs or Seeds; and if by any Cause whatever, one of the Vortexes have more Facility than the other to penetrate certain Seeds or Eggs, it turns them in the manner peculiar to it self. Perhaps each Vortex has generally more influence in the Hemisphere out of which it comes. At this rate the Bodies capable of being turned would affect a different manner in the Southern Hemisphere from that in ours; but it is easie to judge how many Observations are necessary to make good this Fancy: It is sufficient to propose it at present, and to shew some kind of Probability in it.

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*An Extract of a Letter from Monsieur SARRASIN,  
the French King's Physician: in Canada,  
concerning the Castor or Beaver; communica-  
ted to the Academy by Monsf. TOURNEFORT.*

**T**HE largest *Beavers* are 3 or 4 Foot in Length, and from 12 to 15 Inches in Breadth in the middle of their Breast, and from one Hip to the other; they commonly weigh from 40 to 60 Pounds: As to the Length of their Lives, it is thought it does not exceed 15 or 20 Years. These Animals are usually very Black in the most Northern Countries: We meet likewise with some that are White; those of *Canada* are for the most part Brown, but that Colour grows lighter in proportion, as the Countries in which they are found are more temperate; for they are Yellow, and even very near the Colour of Straw in the Country of the *Illinois* and the *Chaouanos*.

The *Beaver*, of which I give an account here, was pretty Black, tho' taken on the side of a little Lake, about 12 or 15 Leagues from *Quebec*, it weighed above 50 Pounds.

This Animal is covered throughout with two sorts of Hair, excepting his Feet, where the Hair is all the same and very short. The Hair of the first kind is of the Length of, from 8 or 10 Lines, to 2 Inches, and grows shorter towards the Head and Tail; this is the Biggest, Coardest, and most Shining, and gives the chief Colour to the *Beaver*: If you view one of these Hairs with a Micro-

Microscope, you see in the middle of it a Line much more transparent than the Sides, which makes me think it is hollow.

The other kind of Hair is a very fine and close Down, of the Length of about an Inch; it defends the Creature from Cold, and serves to make Hatts and Stuffs: The Skins that have been used by the *Indians* for Cloaths or Coverings for their Beds are the most sought after, by reason that they have lost their long Hair, and that the Down which remains is become fat and oily by the Effluviiums that come out of their Bodies, and so are much the better for the use of the Workman. When the Animal is alive and at work, this Down is preserved and defended from the Dirt by the coarse and long Hair.

There are several Particulars relating to the manner of Life of this Creature that are worthy Observation.

1. When the Innundations and Floods are past, the Females return to their Lodgings to bring forth their Young; the Males keep the Field 'till the Months of *June* and *July*, and don't return home 'till the Waters are quite down; then they repair the Damage which the Floods have done to their Houses, or else they make new ones. They change the Place of their Habitation for three principal Reasons. (1.) When they have consumed the Food that was nearest them. (2.) When they are too many of 'em together. And, (3.) when the Hunters are too troublesome to them.

2. When they are about establishing their Dwellings, they make choice of a place plentiful in Provision, water'd with a little River, and proper for making a Lake or Dam; they begin with raising  
a Causey



a Causey of a sufficient Heighth, to bring the Water up to the first Story of their Houses. If the Country is flat, and the River *bollow*, the Causeys are long, but not so high as in the Valleys. These Causeys are 10 or 12 Foot thick at their Foundation, but grow still narrower to the Top, where they don't commonly exceed 2 Foot. As these Animals have a great Facility in cutting Wood, they do not spare it, and they commonly cut it in pieces as big as ones Arm or Leg, and of the Length of from 2 to 4, 5 or 6 Feet; they thrust them by one of the Ends very deep into the Earth, and place them very near one another, crossing them with other pieces of Wood, but smaller and slenderer, filling the hollow Places with Clay, they continue in proportion as the Water rises, that so they may more easily transport the Materials. They stop at last these sorts of Dykes when the Waters inclosed can reach the first Floor of the House they are making; the side of the Causey next the Water is made sloaping, and the Water that weighs according to its Depth, presses it powerfully against the Earth, the opposite side is perpendicular; they are solid enough to sustain the Persons that walk upon them, and these Animals are very careful to keep them in good Repair, patching up the least Breach or Gap with Clay; if they find that they are observed by the Hunters, they either work by Night or else quite forsake their Buildings.

3. The Causey being finished, they work at their Cabins or Houses, of which they always lay a solid Foundation on the Banks of the Water, upon some little Isle, or else upon Piles. Their Houses are round or oval, and stand two third Parts out

of the Water, but they take great care to leave one Door that cannot be stoppt by the Ice. Sometimes they build their whole Cabin upon the Earth, and make Ditches of 5 or 6 Feet in depth, which they bring quite to the Water; they use the same Materials for their Houses as for the Causeys, except, that the Houses are perpendicular, and end in a kind of Dome; the Walls are commonly two Foot in thickness; their Teeth being as good as the best Saws; they cut all the ends of the Wood that stand out of the Walls, and cover the inside and the out with a kind of *Plaistering* made with Clay and dry Herbs; upon this occasion they make use of their Tails to smooth and settle this Plaistering.

4. The inside of the Cabin is vaulted in the Figure of a handle of a Basket, and made fit to lodge 8 or 10 Beavers. Out of work this House has 8 or 10 Foot in Breadth, by 10 or 12 in Length, supposing the Cabin to be Oval. In work it is 4 or 5 Foot broad, and 5 or 6 long: If the number of Beavers is 15 or 20, and sometimes to 30, which however is very rare, the House is large in proportion, and there are even several of 'em opposite to one another. Some Missionaries have assured me that they have found 400 Beavers lodg'd in different Cabins, which maintained a Communication with each other. There are several Stories in a House, to the end that the Creatures may retire as the Waters increase upon them; they have likewise a Hole or Opening distinct from their Door, and from the Place where they wash themselves; the use of those Holes is for discharging their Excrements.

5. There

5. There are of these Creatures that they call Land-Beavers, and these are lodged in Caverns made in a Ground higher than the Banks of the Water. They begin their House by an Opening that is more or less advanced into the Water, according as the Ice may be more or less thick, and they continue this opening 5 or 6 Foot in length, but it has no more breadth than just enough for a Passage; after which they make a little Dam of 3 or 4 foot every way, where they bath as often as they please. Afterwards they cut another Trench or Cavity in the Earth, which rises likewise by Stories, to keep themselves dry as the Waters swell. We meet with some of these that are above 100 foot in length; the Beavers cover the places where they lie with Grass; in Winter they make Shavings, which serve them instead of Mats.

6. All these Works, especially of those Beavers that live in the Cold Countries, are commonly finished in the Months of *August* and *September*, which is the time when they begin to make their Winter Provisions: They therefore cut Wood into long pieces, from 2 or 3 foot, to 8 or 10; the great pieces are drawn by several of these Animals, the little by one only, but by several ways, least they should interfere with each other. At first they put a certain quantity of the Wood upon the Water, where it floats; then they place new pieces upon the former, so heaping on more and more, till their Provision answers to the number of Animals that intend to lodge together: For instance, the Provision for 8 or 10 Beavers is 25 or 30 foot square, upon 8 or 10 foot in depth; this Wood is not heapt up after the manner of our Stacks, but

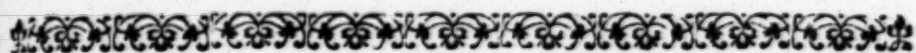


in such a way that they can take it down when they please, and they only eat such pieces as are soak'd in the Water; but before they eat 'em, they cut them very small, and carry them into that part of the Cabin where they lye; if they had cut them down before they had put them into their Wood-yard, the Water would disperse and carry them away.

7. As to the Hunting of those Creatures, it is made from the beginning of *Nov.* to the Month of *March* and *April*, because they are well stockt with Hair. They either kill them by Ambuscades, or they take them with Snares, or by digging Pits for them; the Ambuscade is the most troublesome and least certain way; the most usual is that of laying Snares for them. Tho' the Beavers have laid in their Provisions, they go nevertheless into the Woods from time to time, to seek for fresh Food; the Hunters also that know how much they love fresh Wood, above that which has been floating in the Water, bring them some and lay it near their Cabins, at the same time making such Traps as are used for catching Rats; they plant deep in the Ground several Sticks of 3 or 4 Foot in length, among which there is one laid a-crofs very heavy, raised about a foot and a half, under which they put for a Bait, a Branch of Popler Tree, of the length of 5 or 6 Foot, which leads to another very small Branch; this answers to the cross one with so much exactness, that tho' the Beaver moves the first, *the Cross beam* does not fall, till he cuts the little Branch, and then it always costs him his Life.

8. The way of taking the Beavers by Pits is thus; they make Holes in the Ice with proper Instruments when it is not above a Foot thick; the

the Beavers don't fail to come to these Holes for Breath, and then they kill 'em with a Hatchet. There are Hunters that fill these Holes with the Beards of Corn, or with Straw, that they may not be seen by the Beavers, and then they catch 'em by one of their hinder Feet. If there is any Brook near their Cabins, they cut the Ice a-cross, and place a good strong Net over it, in the mean time another breaks the Cabin to drive out the Beavers, which don't fail to make towards the Hole in the Ice, and so fall into the Snare.



*A Philosophical Account of the FORMICA-LEO,  
or LION-ANT, by Monsieur POUPART.*

**T**HE *Formica-leo* or *Lion-ant*, is an Insect that pretty much resembles a Spider by its Inclinations, by its Manner of Spinning, and by the Figure and Softness of its Body. It has something likewise of the *Hog-louse*, and at first sight one would take it for that little Animal. Its Colour is a dark Grey, it is marked with black Points, like so many little Spears, which make it appear all armed with Quills like a Porcupine, when one looks upon it thro' a Microscope: Its Body is surrounded with several Circles, which makes it appear all wrinkled: It hath six Feet, four are fasten'd to its Breast, and two to a long thing that one would take for its Neck: Its Head is little and flat, its two Horns hard, hollow, of the length of two Lines, a little bigger than a single Hair, and crooked at the end like

like the Nails of a Cat. When one views them with the Microscope they look like the Horns of a great Beetle, which we call a Flying-stag : At the Basis or Bottom of each of those Horns, there is a little black Eye which sees very quick, for the Insect runs away at the smallest Object it perceives.

This Insect is called the *Formica-leo*, because it usually lives upon *Ants* that fall into its Snares : but that should not entitle him to the Name of a *Lion*, being nothing more than the Cunning of a *Fox* ; it would therefore more properly be named the *Formica-vulpes*.

Temperance is of great use to this little Animal, for it lives upon nothing else but some *Ants* or other Insects, that accidentally fall into its Trap ; but the greatest part of his Prey are the *Ants*, because all the little Animals that have Wings escape his Ambushes ; and others are either too big, or their Skin too hard to be pierced by its Horns.

This is his Method for catching Insects, he commonly plants himself at the foot of an old Wall, to be cover'd against the Rain. There must be a very fine and dry Sand in the place, to the end that he may make a Pit or Hole, the Figure of which is a Concave Cone inverted.

When he has a mind to make but a small Hole, he bends his Tail downwards, which ends in a Point, and which he uses like a kind of a Plow-share, with which he tills the Ground, marching backwards, and with little shakings : When he is come to a small Depth, he tosses the Sand very high with his Head, several times, and as fast as he can ; and so his Pit is made. But



But when he would make a deep Ditch, he draws at first a great Circle which is the Basis of the Cone or Pit, that he is about to dig. He then thrusts himself under the Sand, which he tosses up very high with his Head at every Step he makes, always going backwards. As he descends he describes a Spiral Line, which ends inwards at the point of the Concave Cone that he has formed.

His Head is very proper for throwing the Sand, for it is flat, and his Neck very long when he does not draw it in: Thus he is able to give great tosses, as I have seen in those that I have observed, which have sometimes thrown half a Foot from their Dens the Carcasses of the little Insects they have sucked. When the Sand-Den or Pit is finished, he places himself on the side of the Bottom of it, and nothing appears of him but his two Horns, which he opens at the top of the Pit.

Whilst he lies thus in Ambuscade, if any Ant, or other like Insect, passes by upon the brink of his Pit, and throws down any Grains of Sand as it goes along, that is a Warning to the *Formica-leo*, that there is Game for him at hand, with that he tosses up some Sand with his Head upon the Ant, to make it fall into the bottom of his Den between his two Horns, for he never runs after it. But as that does not always come to pass at the first stroke, and the Insect discovers the Snares that are laid for it, it climbs up to get out of the Hole, and sometimes falls back, by reason of the mobility or looseness of the Sand; then it tries to get up again, but the *Formica-leo*, always upon the watch throws more Sand upon it; if the little Creature falls into

his Horns, he closes it in them, and contracts them nearer to his Body, crossing them over one another, then draws the Insect under the Sand, sucking it as long as he finds any Moisture in it.

When there remains nothing more than the Skin of the Ant, he tosses it out of his Den, and if that happen to be demolished, or disorder'd in the Scuffle, he repairs it for fresh Game.

This Animal would rather die of Hunger than go out to seek for his Food, as other Insects do; but it is not thro' Cowardice, as one would be apt to think, that he makes this crafty sort of War; for he cannot do otherwise, because he never goes but Crab-like, backwards and by little Leaps. He is Day and Night upon the watch hid under the Sand in the bottom of his Den; because not being able to hunt for his Prey, he must be content with what Chance brings him, which does not often happen: Thus he is forced to do in length of Time, what Nature will not suffer him to do by Motion or Swiftnefs.

But it should seem, for the Reasons which I am going to alledge, that all these Devices are uselefs for the Subsistence of this little Animal, which one would say does only catch Insects out of Pleasure, and to divert it self like a good Sportsman.

1. He never closes the Insects but with the extremity of his Horns, which do not seem to be hollow at the end of 'em; wherefore it is not very likely that he should draw out the Blood of the little Insects with that part.

2. When one views this Creature with a Microscope, one can't perceive that he puts out any Sting or Instrument proper to suck those Insects he catches,

catches, as several other Creatures do, and one always sees a considerable space between his Head and the Insect that he embraces with the tips of his Horns.

3. I have put several of these Creatures in a Box, and kept them closely shut up in it for six Months together, lest any Insect should fall into their Holes; notwithstanding which they lived like those that one feeds with Flies, and have made their Snares, and the Changes that I shall mention hereafter; which might induce one to believe that the *Formica-leo* can live without Food.

But when one considers that his Horns grow after they have been cut off; that he falls away when he can get no Food; that after having caught but one Insect only he seems much bigger than he was before, and that having suck'd a Fly for the space of two or three Hours, that Fly becomes so dry, that you may Powder it, by rubbing it between your Fingers; I say all this being consider'd, one must be convinced that tho' the *Formica-leo* can live in such a manner, that one does not perceive from whence he fetches his Food, yet he certainly does not subsist without it.

I believe therefore one may look upon the Horns of the *Formica-leo*, as two Syringes with which he pumps out the Juice of the Insect. In effect I have consider'd them with a Microscope used for the viewing Liquors, and which extreamly magnifies the Objects, and I perceived a transparent and membranous Body that ran along the Cavity of the Horn, the Use of which might be the same with the Sucker in the Syringe.

When



When the *Formica-leo* is arrived at a certain Age, and would renew himself that he may appear under another Shape, then he makes no more Snares, but ploughs the Sand, leaving Tracts and very irregular Roads upon it.

After he has been a long time ploughing, he buries himself under the Sand, where he makes a hollow Globe, or Bowl, wherein he shuts himself up, in order to his Transformation. This Bowl is made of Silk, Glue and Sand, all mixt together, he spins his Silk with his Back-parts almost like a Spider. The Glue comes out of all Parts of his Body, and for Sand he has enough in the Place of his Retreat.

To make this Bowl, he turns insensibly into an Orb as upon a Centre, throwing his Back-part every way till he touches the Sand with it, in order to fasten the Silk thereto; which fastening is performed either by entangling the Silk in the rough Parts of the Grains of Sand, or else with a viscous Matter, with which perhaps the Silk it self may be impregnated. But let it happen how it will, the Grains of Sand are so well glued to the Silk, that it is pretty hard to separate them from it, even tho' you shake 'em strongly whilst the Work is yet soft, or rub them with the Fingers.

This Silk is incomparably finer than the ordinary Silk, for you can scarce see it but with the help of a Microscope; to view it well you must dig out the work of these little Creatures, before it be quite finished; you will then find it soft like Cotton, not having been yet harden'd by the Glue which proceeds but very slowly from the Body of the Animal: You must raise this Silk into the Air  
with

with the Point of a Needle, and you will see Spaces between the Grains of Sand as they hang down, without being able to see the Silk it self, so exceeding fine is it, unless you use a Microscope.

It is impossible without some Art to see how these Animals spin their Silk, and how they build their Houses, because they always work under the Sand. You must therefore take away the Work from them several times before it is finished, and then they will begin it again, and at last become so weak with working, that they will no longer have Strength enough to hide themselves under the Sand, according to their Custom, by which means you shall see them slowly spinning their Silk with their back Parts upon the Superficies of the Sand, after the manner that I have already related.

When the *Formica-leo* has wrought a long time, he finds himself in the middle of a great soft Ball, which as yet is only composed of Silk and Sand mixed together : This Ball grows harder by little and little, being moisten'd with a viscous Matter that comes out of the Body of the Animal, and penetrates his House on all Sides.

That which chiefly convinced me that there proceeded a glutinous Humour out of the Bodies of these little Animals, was the seeing several Grains of Sand fasten'd to the Neck of one of 'em, where it made a little hard Rock; whilst he had this Burden upon his Neck, he could make no more Snares, because it hinder'd him from moving his Head; whereupon I broke the little Rock off, and then the *Formica-leo* presently made his Snare,  
and

and sometime after set about making his little House.

When the *Formica-leo* is shut up in his little Habitation, he lines it on the inside with the Silk which he Spins. This Silk being no longer mingled with Sand, is formed into a very close Texture, and resembles a little Pearl-colour'd Satin in which the Animal takes its rest, having his Head folded between his Legs. One might imagine at first, that this Sattin is a dry Glue loosen'd from the Body of the Animal ; but if that were so, it would easily break in the folding or bending of it, which does not happen, nor would it be so flexible as it is : Besides, this little Stuff makes part of his Case, at least it is so well fasten'd to it, that it can't be separated without destroying the Case it self. I put this Sattin into the Water for some Days, but it did not dissolve, as it should have done if it had been a Glue ; however it lost its fine Colour, which made me think that the little Glue that was mixed with the Silk, and which perhaps gave it that fine Gloss, was dissolved, and the Stuff left alone. This little Sattin is pretty like that which is made by certain Spiders upon the Leaves of Trees, serving them for a Lodging or Nest to lay their Eggs ; but it is thicker than that of those Spiders.

To shew that the *Formica-leo* does not work upon this Tapistry, nor hang his little House with it, till it be quite built, if you open it before it be grown hard, you will not find it hung with the Sattin we have been speaking of.

My *Formica-leo*'s remained in their Lodgings for the space of six Weeks or two Months before they



they were turned into little Worms; but the time of their stay is not fixed: They had put their Heads between their Legs, to make themselves as round as possible, to the end that they might take up the less place, and accommodate themselves the better to the Concave Figure of their little Bowls.

When the time of their Metamorphosis came, they began to strip themselves of their first Skin, to which their Horns, their Eyes, and their Hair remained fasten'd. That Skin was whitish within-side, with an opening all the length of the Belly, out of which the Insect, which I am about to describe, proceeded.

After that the *Formica-leo* has shed his Skin, he appears under the Form of a little Worm, which is about three Lines in Length, having four membranous Wings, six Feet, two great *Antennæ* or Horns, soft and hollow, two black Eyes, and two Pinchers in the form of Saws, which serve him for Teeth. This little Worm remains sometimes in this Condition before it appears under a new Form, but one cannot tell how long, because the *Formica-leo* from which it proceeds, shuts himself up in his House when he is to be turned into a Worm.

When the Worm would come out of its little House to be metamorphosed, it gnaws a little round Hole therein with its Teeth, which are pretty like those of a Grasshopper: However, the Hole that he makes does not appear round, because the piece commonly remains fasten'd at one end, which renders the Passage so strait, that half the Worm remains in the Case, and t'other half out.

In

In this Condition the little Worm is no longer living, 'tis only a membranous and transparent Case, with Horns, Eyes, Teeth, Wings, Feet, &c. which are the Case of the like Parts of a fine Fly that we call a *Demoiselle*, that comes out of the same Tuy or Case, by a little Hole made upon the Back near the Head. This Fly is 15 or 16 Lines in Length, but his Wings at first are no more but 2; because having been shut up in Cases that were no longer, they were forced to take the Figure and Size thereof. These Wings are moist and pleated in several Folds, which are open'd in two Minutes time, and become longer than the Body.

When the Fly comes out of its Case, it remains sometime upon its Feet to dry its Wings, that it may fly, and enjoy a more merry Life than that which it passed under the Skin of the poor *Formica-leo*.

Whilst this Fly is in the Case of the Worm it can have but 3 Lines in Length, because the Worm it self is no longer; but so soon as it gets out it stretches it self as far as 15 Lines. This sudden unfolding proceeds from hence; whilst the Fly is still in its Case, it is shorten'd and folded as a *Courcaillet* which one squeezes at both Ends: But as soon as it comes out of that Skin, it stretches it self to its whole Length, like a Sponge pressed between the Fingers, which resumes its natural Bigness as soon as you cease to press it.

In the Year 1703, the *Formica-leo*'s that I had observed, did not turn into Flies; that Metamorphosis not happening till the Year after: This makes me think that these little Insects are not changed in the first Year of their Life, and that it is necessary

sary for them to arrive at a certain Age before their Transformation.

After that the Fly is come out, if you open the little House, in which the *Formica-leo* was shut up, you will find, as we said before, that it is hung with a small Sattin very sleek, and of the colour of Pearl: You will likewise find there the Skin of the *Formica-leo*, which is flatted and stuck with Hairs, as have been before observed; you may also see the Membranous Case, in which the Fly was immediately inclosed. But that which is particular in it is, that you will sometimes find an Egg there, which the Fly had laid before she came out: This Egg is two Lines in Length, and one in Thickness, and is something like a little *Gland* lengthened out. Its Shell is hard, and altogether like that of a Hen's Egg: The Substance contained in it is not Fluid, and I observed that the Egg changed its Colour at different Times: I exposed one of these Eggs to the greatest heat of the Sun for the space of several Days, and the Matter that was inclosed in it became hard and as black as Ink.

It seems as if these little Flyes did lay but one Egg, for we could find no more in the Bodies of some of them which we opened; there was only one that another had laid in its House before it came out of it, and one Fly fastening it self to the Top of the Box in which it had been shut up, did likewise lay an Egg some Hours after. However, it is not likely that each of these Flyes should lay but one Egg, because there is always some of them that are barren, and others that produce Males; from whence we may easily conclude, that by  
little



little and little the Species would have entirely failed.

One may see by the Precipitation with which these Flyes lay their Eggs, that they don't always wait for the Approaches of the Male for laying them: It is perhaps, because of the seldomness of these Coitions, that the *Formica-leo*'s and the little Flyes that proceed from them are pretty scarce.

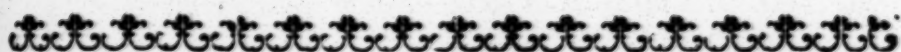
The little Bowls in which the *Formica-leo*'s are shut up, are absolutely necessary for the Production of the Flyes; for I broke some of them, that I might lay the *Formica-leo* upon the Sand at the time when it was ready to be Metamorphosed, notwithstanding which it did not forbear to shed its Skin, but the Fly would not come out of the Worm, in which it was shut up, tho' it lived a great while afterwards, and made several Motions and Attempts to get out. One of the chief Uses of this Bowl is, that by its Means the Fly gets out of the Worm in which it is shut up, passing with Difficulty thro' the little Hole that the Worm it self makes with its Teeth.

It must be observed, that the different *Demoiselles* or little Flyes, that during the Summer time swarm upon the Water in the Ditches and about the Hedges, do not all proceed from this little Insect. Those that come from it have two *Antennæ* or Horns that are smallest next the Head, and grow bigger towards the upper end: They have two great Eyes on the sides of the Head, but none at Top like the other kinds of Flyes; their Belly is not streakt all the length of it, as it is in others, and the end of their Tail is cover'd with Hairs: Their Wings are of the Colour of white Ashes, and little black Spots on

on them, but not diversified with any lively Colours. Wherefore it is likely, that those fine Flies, to which the variety of Colours has given the name of *Demoiselles*, as well as all their different kinds are of another Extraction.

There are two other fine Sorts of great *Demoiselles*, the Origin of which is very different from those we have been speaking of; they proceed from two watry Insects, that do not at all resemble the *Formica-leo*.

We shall shew some time or other that the Insects from whence these larger kinds of *Demoiselles* proceed, are really Fishes, for we have observed their *Gills*, &c.



### A Philosophical Discourse upon the different Heighths of the RIVER SEINE at different Times.

Very thing is worthy to be observed, and the Obscurity of Physicks is not perhaps more owing to the Ignorance of Causes than to that of even the Effects themselves. Monsieur Amontons had begun to cause the Heighths of the Seine at different times to be observed by one of his Friends, the Situation of whose House furnished him with an opportunity of doing it. This Friend of his, who was a nice and able Observer, had taken a fixed Point upon the *Massif* of the New-bridge, or *Pont-neuf*, upon which the Equestrial Statue of *Henry the Fourth* is placed. From thence he computed, Day by Day, the Risings and Fallings of the Seine, upon an im-

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moveable

moveable Graduation which he had made there, and which he viewed with a Telescope. *Monf. Amontons* having received from him the Journal of these Observations, from the 14<sup>th</sup> of *Sept.* 1703 to the last of *Decemb.* 1704, he reduced them to the following Method.

He divided the whole into Elevations and Descents of the Water, noting for instance, how many Days the Water had risen from the beginning of the Observations, and how high; then how many Days it had fallen, and how low; after that, how many Days it had begun again to rise, and so on.

By the single Journal of those Observations, one might see, what Time of the Year the River was highest or lowest, and how much one Year differ'd from another, &c. and by this Division of Observations into Elevations and Descents of the Water, one might see likewise the number of the Elevations and Descents of each Year, their Duration, their Greatness, and all their Relations, according to these different Ways of considering them.

For instance, *Monsieur Amontons* found that from the 14<sup>th</sup> of *Sept.* 1703, to the 10<sup>th</sup> of *Feb.* 1704, there had been 8 Elevations, which altogether made 223 Inches, and had lasted 77 Days; that from the 10<sup>th</sup> of *Febr. ditto*, to the 18<sup>th</sup> of *Sept.* following, there had been 8 other Elevations, which amounted to no more than 163 Inches, and had lasted 70 Days; from whence he concluded, that the Rains which contribute to swell the *Seine* had been much more precipitated, and succeeded one another more closely from the Autumnal Equinox in 1703, to that of the Vernal in 1704, than since this last Equinox to that of the following Autumn, because the  
Amount



Amount of the first Elevations was almost double to that of the other, and yet the two Periods of Time were almost equal.

As to the different Descents of the Water in the same time, it was found, that their Greatness or Quantity, was more proportionable to their Duration; from whence one may conclude, that the Waters not falling as swiftly as they rise, it is probable that at the time that Rivers swell, they drive their Waters over the Grounds, which return afterwards, and serve to maintain them.

We do not offer these Observations, but as a Sketch of the Consequences which one might draw from a sufficient number of more exact ones, upon the Height of Rivers, in different Times. We hope that those who have the conveniency of making 'em, and who have a Taste for the Advancement of Natural Philosophy, may hereby be invited to give themselves that Trouble.



Upon YELLOW AMBER.

THE finest Sort of the *Yellow Amber* comes from the two *Prussia's*, and that it comes from thence in greater quantities than from any other Country, the Academy is perhaps less instructed in that Matter than those who have done 'em the Honour to consult them about it. They will however publish all they know concerning it themselves, and will likewise add their Observations. They don't intend to take notice of what other Authors have said upon

it, being perswaded that it is not a Collection that is expected from them.

Messieurs *Cassini* and *Miraldi* being gone in the Year 1700 into the Southern Provinces of *France*, to work there upon the Prolongation of the *Meridian* of *Paris*, they found some Mines of *Jett*, and a kind of *Yellow Amber*, in a Mountain of *Languedoc*, called *Bugarach*, which is at the distance of 27600 Fathoms from the Sea, and is separated from it by divers other Mountains that are very high. Some are of opinion that *Jett* as well as the *Yellow Amber*, is a Species of the *Succinum*. The Inhabitants of *Bugarach* make use of the *Yellow Amber* to burn in their Lamps; it resembles pretty much *Rosin*, and is not so hard as that of *Prussia*. Near the Mines of *Bugarach* there are some Springs of Salt Water, which together form a little River.

There is *Yellow Amber* found in the Clefs of the Rocks in some of the most barren and naked Parts of the Country of *Provence*.

We are likewise assured by very credible Accounts, that there is found of it in *Sicily* too, upon the Sea side, along the Coasts of *Agrigento*, *Catanea*, *Leocata*, in the Island of *Corfa*, and even at *Bologna* in *Italy*, towards *Ancona*, and in the *Umbria* far from the Sea, and a great way up in the Country.

This being joyned with what the Marquis *de Bonnac* informs us, who himself has seen *Amber* dug out of the Lands of Monsieur *Grata*, separated from the Sea by great Woods, and high Hills, which *Amber* is exactly like that found on the Sea-side, the Question seems to be decided, that *Amber* is always produced in the Earth.

Besides,

Besides, we meet with little Animals imprison'd in it, and they are always terrestrial Animals, such as Flyes, Ants, &c.

However, for greater Certainty, it would not be amiss to enquire whether the Terrestrial Ambers have all the Characteristicks and the Goodness of that which is found upon the Sea-side; for it is not impossible, but that the Sea may by its Salt work this matter, and give it the last degree of Concoction.

Supposing that *Amber* be always produced by the Earth, it remains to know whether it should be accounted a Vegetable or a Mineral?

We have never heard that there are in *Prussia* any Trees that distil *Amber* like Rosin or Gum, or any other Matter of the same kind; and yet it appears much more natural that the Flyes and Ants which we see in it sometimes, and which plainly prove that it has been liquid, should have been involved in a Gum dropping from a Tree, than a Mineral formed in the Bowels of the Earth: To solve this Difficulty, we must suppose this *Amber* to have run out of some Rocks, like the Oil of *Petroleum*, or at least that that, in which we find the little Insects, may have been liquid for a while, after it came upon the Surface of the Earth.

Whether *Amber* be allowed to be either a Vegetable, or a Mineral, no body has ever yet affirm'd that he has seen it liquid, or even soft: Nevertheless it must have been so, and even exposed to view, at the time when it involved the Animals that are found in it.



The Analysis, or Resolution of this mixed Body, made by the Chymists belonging to the Academy, does not entirely determine of what kind it is. They have always found a very small quantity of a watry Liquor, which had the Odour of *Amber* rubbed, a great deal of an Acid Volatile Salt, and a great deal of Oil, part of which was clear like Water, part Brownish, and some very Black, according to the Degrees of Fire used in the Distillation of it. There remained a *Caput Mortuum*, light, spongy, black and shining, which having been calcined in the naked Fire, evaporates almost all in Smoke, and they could draw no fixed Salt from it.

The only difference of the Resolutions of the several *Ambers* is, that the most transparent or whitest, yield more Oil and Volatile Salt, and less of a *Caput Mortuum*, than those that were of a more dark or blackish Colour; the latter never yielded any fixed Salt, tho' the *Caput Mortuum* was in a larger quantity.

The Oil of *Amber* has an Odour of Bituminous Oil, which would seem to denote that *Amber* is a Bitumen; but there are certain Rosins of which the distilled Oil has the same Odour.

There is some also like the *Benjamin*, which yields an Acid, Volatile Salt: But there is none that we know of that yields at the same time both an Acid Volatile Salt, and an Oil of a Bituminous Scent. Wherefore the Academy is more inclined to believe that *Amber* is a Bitumen, and consequently a Mineral.

It is easie to see how much Light is still wanting to the Academy, before they dare come to a precise Judgment upon every thing concerning *Amber*, for they should be informed, *First*, Whether there be not some

some Salt or Vitriolick Water, in the Neighbourhood of those Places, where *Amber* is produced.

*Secondly*, Whether it be found commonly involved or mixed with Earth, or other particular Substances?

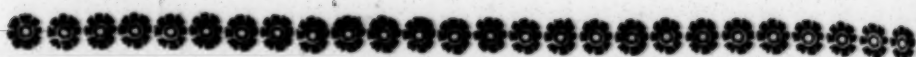
*Thirdly*, Whether there are any Marks or Tokens whereby to discover in the Earth, the Places that produce *Amber*?

*Fourthly*, Whether the Fossil *Amber* is any ways different from that which is found on the Seaside?

*Fifthly*, Whether the White sort be found in the Earth as well as the Yellow; or, whether the Yellow don't turn White when exposed to the Air and Sun?

*Sixthly*, Whether they find any Black *Amber* in the same Places where they meet with the Yellow?

*Seventhly*, Whether it be very sure, as it is affirmed by *Philip James Hartman*, in his History of the *Amber* of *Prussia*, and by *Bartholine* upon that of *Denmark*, that there is found of it under a kind of Earth, Foliated and like the Barks of Trees, and that it is attended with a kind of Fossil Wood, in which however one can't distinguish neither the Pith nor Fibres, nor Knots, nor Buds. All these Facts well attested, would give great light into the Nature of *Amber*, and if the Cardinal Primate would be pleased to employ some skilful Person in these Enquiries, the Academy would be obliged to his Eminency for their more certain Knowledge therein.



## Upon the Generation of IRON.



*O find the Solution of Old Difficulties, is without doubt an Advancement in the Sciences, but it is no less so, to unravel New Difficulties, and yet more to discover some in which, at first sight, there appeared none at all.*

Monfieur *Geoffroy* enquires here of the Chymists, Whether there are any *Ashes* in which there is no mixture at all of *Iron*? One shall probably be startled at the Question, for whence can proceed the Impossibility? Why should People expect to find any *Iron* in the *Ashes* of *Burnt-wood*? And yet the matter of Fact is certainly true, and those *Ashes* have always some, at least all those that have been examined by Monfieur *Geoffroy* had *Iron* in them, and it was upon the following occasion that he discovered it.

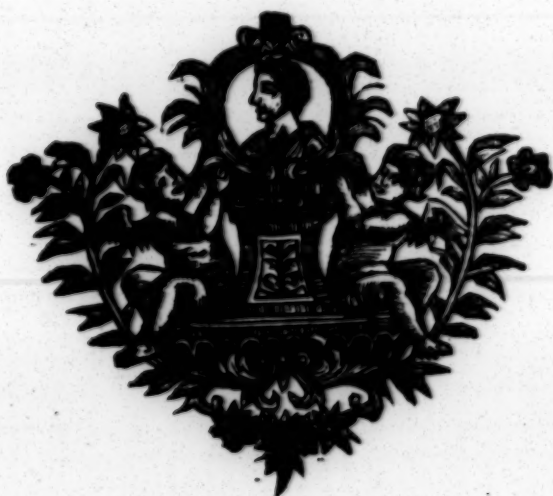
He had made some Artificial *Iron*, composed like the common Sulphur, of a Sulphurious Principle, or of an Inflameable Matter, of a Vitriolic Salt, and of a Terrestrial Substance. To repeat the Experiment, and to be the more secure of Success, he sought for an Earth, or *Ashes*, perfectly divested of Vitriolic Salts, and especially of Ferrugineous Particles, his design being to make *Iron*; but whatever Precautions he took, tho' he made *Ashes* in Places where there was no *Iron* at all, and tho' he made them of a Wood that had never been sawed with



with *Iron*, he could never get them entirely exempt from the Particles of *Iron*; if at least one may reckon among the Particles of *Iron* all such as are attracted by the Loadstone, which seems to be past doubt.

It is not probable that these Particles of *Iron*, heavy as they are, and so little Homogeneous, or Connatural to the Sapp of Plants, can rise up with them into the Wood, of which the Ashes were made.

Should it be then likely that every time the Wood is burnt, *Iron* can be produced by the mixture of the Three Substances whereof it is formed? Monsieur *Geoffroy* begins to Conjecture it, and nothing could agree better with the Opinion he has already conceived about his Artificial *Iron*; but above all things, we ought to be very well assured that there are no Ashes without *Iron*. One of the greatest Difficulties in Philosophy is, not to be too hasty with new Systems.



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*Upon a Dissolution of SILVER.*

**I**F one could reduce Chymistry and Physics in general to Kinds of Universal Forms, which might contain all the possible Cases, as the most sublime Questions of Modern Geometry are reduced, one should be able to foresee the Changes that would answer to the different Hypothesis or Suppositions that one would make; and one should often see very small Changes in the Suppositions produce very great Variations in the Effects. But Natural Philosophy is of too great an extent, and too little known, at least till now, and Experience alone reaches us, how great a Power there is in Circumstances to vary the Phenomena. *Monf. Homberg* gives a remarkable Instance of it, in the Dissolution of *Silver*, performed by the Dissolvent of Gold.

The Spirit of Sea Salt is the proper Dissolvent of Gold, and the Spirit of Nitre is the proper Dissolvent of Silver. The Spirit of Salt mixed with the Spirit of Nitre dissolves Gold best; 'tis that which predominates in the *Aqua-Regia*. The Spirit of Nitre mixed with the Spirit of Salt ceases to dissolve Silver. 'Tis the Spirit of Nitre that is predominant in the *Aqua-fortis*.

Upon these Facts, *Monsieur Homberg* supposes, with great probability, that the Pores of Gold, which is much heavier than Silver, are more close, and the Points of the Spirit of Salt more fine  
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than those of the Spirit of Nitre; that they are so, more than would be absolutely necessary, for the smallness of the Pores of Gold; that the Spirit of Salt, joined with the Spirit of Nitre, forms a Body of a middling greatness, still capable of entering into the Pores of the Gold, in which they have the effect of a Wedge, and separate the solid Parts of it; that the Spirit of Salt being united to the Spirit of Nitre, acts more powerfully than if it were alone, because according to the Principles laid down by *Monf. Homberg*, in his *Essays of Chymistry*, the Spirit of Nitre is attended and cloathed with a Vegetable or Animal Sulphur, more rarified, more volatile, and more active than the metallick Sulphur that adheres to the Spirit of Salt; finally that the Composition of these two Spirits does not dissolve Silver, because the middling Body which they form, is still too fine for the Pores of that Metal; that it is too much at large in those Pores, and consequently does not make a sufficient Impression on them.

These Principles being admitted, what Effects can be produced by an *Aqua-Regia* composed of the Spirits of Salt and Nitre, but each of them in so small a Quantity that they will float separately in the Liquor, and will not meet one another often enough to be united, at least in a great Number of Parts.

This Water may be so weak that it will seem not capable of dissolving Gold, and will only assume a yellow Tincture, which does not sensibly diminish the Weight of the Metal. Nor will it dissolve Silver neither, because of its weakness, and in general, it will dissolve neither the one, nor the  
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the other of those Metals, because put which you will of them into such Liquor, there will always be one of the two acid Spirits that will make, as I may say, vain attempts against the Metal usurping the place of the Particles of the other Spirit, which might have acted more efficaciously, but if such *Aqua Regia* has dissolved as much of the Gold, as it is able to do, if it has drawn a yellow Tincture from it, it may still dissolve Silver after that; for the Spirit of Salt, whether all alone, or whether it be united with the Spirit of Nitre, being Employed in keeping dissolved the few Particles of Gold, it will not attack Silver any more; which by Consequence receiving the Impression of a greater Quantity of the Spirit of Nitre only, will suffer it self to be dissolved. But this Experiment can't be turned the contrary way; that is to say, the *Aqua Regia* can't begin by a slight Dissolution of Silver, and afterwards proceed to dissolve Gold; the reason whereof is, the Spirit of Nitre does not hinder the Spirit of Salt from acting upon Gold, as the Spirit of Salt hinders the Spirit of Nitre from acting upon Silver.

From all which it follows, that if the Spirit of Salt and of Nitre, which we have supposed to float separately, should come in time to be united in all their Parts, that Liquor would only perform the Office of the *Aqua Regia*, and will dissolve nothing but Gold; whereas before, when it had dissolved Gold, it would have dissolved Silver also.

*Upon the Nature of IRON.*

 *Iron* among all the Metals, is that which has the greatest Uses in the Practice of Physick, and at the same time that which in Speculative Philosophy mostly attracts the Curiosity of the Philosophers, because it has its share in the Phenomena of the Loadstone. Monsieur *Lemery* the Son, and Monsieur *Homburg*, have both made it an Object of their Studies; the one by the ordinary Chymistry, the other by his new Chymistry, the only Furnace of which, is the Burning-Glass in the Royal Palace.

The Result of Monsr. *Lemery's* Operations is, that *Iron* is an oily Matter, intimately united to an Earth. According to him there is nothing of an acid Salt in that Composition, not but one may find something of it in the *Iron*; but as that Metal is pretty much indigested, and, as one may say, but coarsely wrought by Nature, there may be in it foreign Particles not belonging to its real Substance. Thus Acids may be admitted into its Pores without being any way a Principle of this Mixture; and so far are they from being Principles, that Monsr. *Lemery* shews, they are its Dissolvents; that is to say, its Enemies and Destroyers. The Spirit of Salt, of Nitre and other Acids dissolve *Iron*; and when it is rusty, it is dissolved either by the Acids of the Air, or by those it contained in its Pores, and which Water or some other Liquor has put into motion. If it should hereafter appear that  
Acids

Acids are excluded from the intimate Composition of *Iron*, there must be a Restriction to the Formation of artificial *Iron*, mention'd in the History of 1704, and it must be owned that the Acids that enter'd therein were not necessary to it.

Vitriol is *Iron* intimately mixed with an acid Spirit; and with such a Composition one may make Artificial Vitriol, very like the Natural. Monsieur *Lemery* having dissolved both the one and the other Kind of Vitriol over a great Fire, he extracted the acid Spirit from them, attended with a very strong Odour of common Sulphur, which lasted several Months after the Distillation. Vitriol calcined, and made *Colcofar*, being again melted over a very violent Fire, which made it yield a fresh Odour of Sulphur, there remained at last in the Vessel, a black rarified Powder, which the Loadstone attracted as strongly as it does *Iron* or *Steel*.

We know that common Sulphur is composed not only of an oily Matter, but likewise of an acid Spirit; without which, the former would not be Inflameable. It is therefore very probable, that in the Vitriols there is formed a common Sulphur, by the Union of the acid Spirit with the oily Particles of *Iron*; and that this Sulphur becomes sensible to the Smell by the Action of the Fire. The black Matter that remained after all the Operation was still *Iron*, since it could be drawn by the Loadstone, but it was an *Iron*, either almost or altogether divested of its oily Parts. Therefore it was no longer Malleable, for it is its oily Parts that give it the Facility of being beaten out with the Hammer, but it was become fryable or brittle almost



almost like a Stone; it could be hardly any longer dissolved by any Acid, because the Acids that ferment violently with the Oils could take no more hold upon it, and by the same reason also, it would no more rust.

The same Operations that were made upon the Natural and Artificial Vitriol, were likewise made upon the Rust of *Iron*, the most perfect that could be got, and the success was in a manner the same. As Vitriol has more Acid in it than the Rust of *Iron*, and that the oily Parts are not separated from these mixed Bodies, but in proportion to the quantity of the Acid that carries them off, there was more of the oily Parts separated from the Vitriol than from the Rust, and consequently the Matter that remained of the Rust, after the Operations were over, was in a better state to be still imperfectly dissolved by some Acids. It appears then, that the Parts of *Iron* are separated, and even easily enough, with respect to the difficulty of uncom-pounding other Metals. 'Tis from thence that it becomes useful in Physick, and probably the good Effects that are produced by it are owing to its oily Parts, separated from the Earth by the Chymical Operations made in the Bodies of Men.

Monf. *Lemery* having appropriated the oily Parts of *Iron* to Medicinal Uses, he gives the earthy Parts to the Magnetick Phenomena; not that all Kinds of Earth can be proper for it; for there must be a very particular Disposition of the Pores, and perhaps it is the oily Matter that molds and fashions them as far as is necessary for that purpose. Hence Monf. *Lemery* conjectures that the Loadstone might have been *Iron* originally, from which

which the Heat of the Earth had separated the oily Parts. In short, no more is wanting to make the whole Difference between a Metal such as *Iron*, and a Stone, such as the *Magnet*, and it is known how much those two are alike otherwise.

How comes it then that the *Iron*, divested of its Oil, and reduced to such a State as was done by *Monf. Lemery*, does not attract as well as the Loadstone? The Answer is at hand; the *Iron* is then a Powder, and the best Loadstone in the World being beaten to Powder does no longer attract; the Cause of which is this, there is no Vortex or Whirl-pool formed about each little Grain, or if there be, it is not strong enough: Nor is there any formed about all the Grains together, which have not among themselves any regular continuation of Pores; the Powder of Loadstone which has lost its attractive Quality, is always drawn exactly after the same manner as the earthy Parts of the *Iron*.

If *Iron* dispoiled of its oily Parts, was not reduced to a Powder, and if it were besides sufficiently exposed to the Current or Stream of the magnetick Matter, so as it could collect and retain a Vortex about it self, it would, according to this System, become a real Loadstone. It is thus that *Monf. Lemery* pretends that some rusty pieces of an *Iron-Bar*, that was in the Belfry of *Chartres* did acquire a Magnetick Virtue: The Acids of the Air, or the foreign Acids lodged in the Pores of the Metal, had dissolved the oily Parts of its Superficies, the Heat of the Sun had in length of time carried off, both the Dissolvents and that which they had dissolved, and the Magnetick Matter that circulates about the Terrestrial Globe, had  
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for a pretty long time passed into this *Iron* which was deprived of its Oil. According to *Mons. Lémery*, *Iron* is not changed into a *Magnet* on account of its Rust; it is only disposed to such a Change, and it must afterwards be unruined; that is to say, the Oil dissolved by the Acid, must be separated from the *Iron*. Now tho' *Mon. de la Hire*, as we have related it in the History of 1705, does attribute the Change to the Rust, it would not perhaps be hard to reconcile those two Opinions.

On the other hand *Mons. Homberg* examined the Nature of *Iron* by the Burning-Glass, and his Dissertation upon that Subject, published in 1706, gives the Detail of his Experiments, to which we must refer the Reader, since it neither can nor ought to be Abridged, by reason of the too great Number of the little nice Circumstances, all of which are important. The principal Consequences that flow from *Mons. Homberg's* Observations are these :

1. That *Iron* has a certain quantity of superfluous oily Matter, which is separated from the Parts that are truly Metallick; and this confirms what we have said above, that *Iron* is an ill-digested and ill-wrought Metal.

2. That this oily Matter, or the Sulphur of the *Iron*, being joyned to Coal, or some other Matter of the like Nature, is inflameable. Perhaps that is an Effect of the Union of this Sulphur with the Acids of the Coal.

3. That the Sulphur of *Copper* is inflameable like that of *Iron*, but so is not the Sulphur of *Gold* or of *Tinn*; tho' *Gold*, *Copper* and *Tinn*, are three Metals very Sulphureous. It is very probable,



bable, that without the assistance of this Burning-Glass, one should never be able to discover these nice differences between the intimate Principles of the Composition of Metals.



### Upon the Nature of HONEY.

WE do no longer believe, like the Ancients, that *Honey* is formed of the Dew which falls upon Flowers ; nor is it any longer taken for a Production of the Air, or a Present from Heaven. The Bees do not gather it till after Sun-rising, at the Time when there is no longer any Dew, and what they take upon the Flowers, must either be a Liquor which is prepared there, and which comes out of the Flowers by particular Vessels, as the Manna comes from the Ash of *Calabria*, or rather the fine and loose Dust in the Stalks of Flowers ; for according to the Observations that *Monf. du Verney* has formerly made upon this Matter, the Bees only apply themselves to these Stalks, and not to the places from whence any Liquor can proceed.

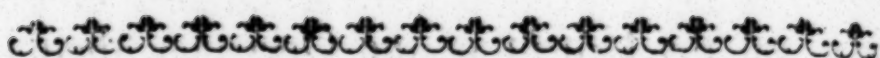
*Monf. Lemery* has examined the Nature of Honey by Chymical Resolutions : He has tried that of different Countries, from *Narbonne*, *Champaigne* and *Normandy* ; the Honey diminishes in goodness according to the Order of these Places that have been named ; but there is little difference in the Analysis of them.

Three quarters of the Substance of Honey goes off in Liquor by Distillation. Of this Liquor,  
 I which

which changes according to the Degrees of the Fire, and the Length of the Operation, there is above a fourth Part, which is nothing but an insipid Water to the Taste, and yet Acid in it self, because it will turn the Marigold red; almost all the rest is a Water sensibly Acid, which is called the Spirit of Honey; there comes but very little Oil from it. The fourth Part of the Substance of the Honey that remains solid is a black and light Coal, which when thrown into Water, boils in it like Chalk. By Lixiviation they extract a little Alkali Salt from it.

Of all that proceeds from the Honey, nothing preserves the taste of it, nor even any taste like it, but this is no wonder; the Savour as well as all the other Properties of mixed Bodies depends upon a certain Concatination of Principles. *Monf. Lemery* is of Opinion that Sweetness proceeds from a close Mixture of an Acid with a Sulphur, or with an Oyl that temperates and corrects it; he supports his Conjecture by the instance of Sugar of Saturn, so called from its Sweetness, which is Lead, a Metal insipid in its self, but very Sulphureous, dissolved by an Acid. It is not always easie for Art, neither to make a Mixture sufficiently intimate of the two Matters that compose Sweetness, nor exactly to hit upon the Dose thereof.

*Monf. Lemery* had a mind to try whether the Spirit of Honey rectified would dissolve Gold and other Metals, as several Chymists have maintained. He found that this Spirit did extract a yellowish Tincture from Gold, and a little Odour without Tincture from Copper; that it penetrated Iron, Lead and Mercury; but not Silver nor Tinn.



### *Upon the Iron of PLANTS.*

**T**HE Operations of Monsieur *Lemery* upon Honey have furnished him with an Answer to a Question proposed by *Monf. Geoffroy*, in the History of 1705. *Whether there can be any Plants without Iron?* No matter drawn from Plants should seem to be more exempted from Iron than Honey, which is nothing but a very fine Extraction from Flowers, wrought again in the Bowels of the little Body of a Bee; nevertheless Monsieur *Lemery*, after having taken all possible Precaution against any Iron that might have accidentally been mixed with his Operations, found in the black Coal, that remained from the Distillations of Honey, small Grains that were drawn up by the Loadstone.

Moreover Monsieur *Lemery* found some Iron likewise in the *Castoreum*, which is a Matter proceeding from an Animal.

From hence it must follow, either that some other Substance, besides Iron, can be attracted by the Loadstone, or that there is Iron formed by the Calcination that makes the Ashes, or finally, that it is really contained in Plants, and even in some of the Parts of Animals too. Monsieur *Lemery* holds the latter.

These Grains extracted from Plants, and upon which the Loadstone acts, are melted with the Burning-Glass, exactly after the same Manner, and with the same Circumstances as the Filings of Iron; why then should it not be real Iron? One



One ought to presume that it is so, if nothing hinders us from believing it, and it is by following this kind of Reasoning that Monsieur *Lemery* answers all the Difficulties which may be objected. As narrow as the Tubes and Vessels of Plants are, he proves, that *Iron* may be divided into Particles small enough, to pass easily thro' them. As heavy as it is, it can be raised when dissolved in a Liquor; it is beyond dispute that there are Particles of Earth that ascend into such Vessels.

A more particular Enquiry into the Facility wherewith *Iron* is raised up into Plants, has led Monsieur *Lemery* to a curious Experiment. Upon a Dissolution of Filings of *Iron*, by the Spirit of Nitre contained in a Glass, he poured Oil of Tarter *per Deliquium*; the Liquour swelled very much, tho' with a moderate Fermentation, and a little while after it had rested, there arose kinds of Branches fastened to the Superficies of the Glass, which continuing still to spread and grow, cover'd it at last entirely, and then spread themselves even upon the External Superficies. The Figure of the Branches is so perfect, that one may discover in them even kinds of Leaves and Flowers, and this Vegetation of *Iron* may as justly be called the *Tree of Mars* as a Vegetation of Mercury, tho' in a different manner, has been termed the *Tree of Diana*. If the Liquor which in ascending gets over the Glass, without making any Branches, is turned upside down, it quickly begins to ascend again, and is congealed into Branches, either wholly or in part; so that you need only turn the Glass, and that which remained Liquid about it, will at length be

all spent in the Formation of the Tree. There is some small Variation in the Effects, which depends upon the Dose of the Dissolution of *Iron*, and of the Oil of Tartar.

The extream Volatility of this Liquor can only be attributed to the *Iron*, since it is certain that the Spirit of Nitre and the Oil of Tartar mixed together would not produce such a Vegetation. From thence Monsieur *Lemery* easily comprehends how *Iron*, dissolved in the Earth by Acids, ascends even to the Tops of Plants, and perhaps it likewise helps the Elevation of the Sapp; he might fancy too, that the Figure which the *Iron* naturally takes, when it ascends in the Glass, may contribute to that of the Plants, where it is contained, and does in some manner cause them to put forth Branches; but this Conjecture is a little too new yet, and even contrary to several strong Appearances, and must therefore be proposed with Caution. *It is good to venture sometimes after this manner as Physicians do with their Medicines, but then you must follow their Example, and use the necessary Precautions.*



Upon what becomes of the AIR that enters into  
the LUNGS.

**I**T seems as if every thing becomes Difficult the more we fathom into it, and that one need only examine a Matter with greater Care, and thro' all its Relations and Dependances, in order to be more inquisitive about the Explanation thereof.

We have seen in the History of 1700, that Monsr. Mery does not allow that the Air received into the Body by Respiration, and then mingled with the Blood, can afterwards get out thro' the Pores of the Skin, with the Sweats, or all that great quantity of Matter which we continually perspire. His strongest Argument is, that Animals put into a *Vacuum* swell by the Dilatation of the Air contained in their Bodies, which Air cannot get thro' their Skin without bursting it. This seems conclusive enough, notwithstanding which, a Philosopher has offer'd a considerable Objection against it, viz. Take a little Sweat, put it into a Vessel, and place it in *Vacuo*, you will see the Air come out of it, as it does out of all other Liquors; therefore there is Air in Sweat, and consequently it can, and even ought to come out with it, by the Pores of our Skin.

In Answer to this Difficulty, Monsieur Mery distinguishes two Kinds of Air contain'd in the Bodies of Animals, or rather two different Ways by which it enters them. There is Air intimately



mixed with all the Food, whether it be Liquid or Solid, that Living Creatures use; besides which they continually take in Air in the Mass, by Respiration. The Blood which is formed from Food, is all Impregnated with the Air inclosed therein; and Monsieur *Mery* conceives, that as the Food had taken in as much Air as it could contain, the Blood was in the same Disposition, and like to Water that has dissolved all the Salt it was capable of imbibing. But as the Water may still admit Salt into a Mass which it cannot dissolve, so the Blood receives by Respiration a Quantity of Air that does not intermix with it, but remains in a Mass, and only serves to quicken its Circulation. The Air that comes out of Sweat *in Vacuo*, is what was intimately mixed with it, and likewise with all the other Liquors of the Body; but the Air taken in by Respiration, remaining always in the Mass, goes out likewise after the same manner, and consequently must take the same way in going out as it did in coming into the Body; that is to say, as it passed from the Vesicle of the Lungs into the Extremities of the Capillary Veins of the same, and from thence is carried with the Blood to the Extremities of all the Capillary Arteries of the Body; so it must pass from those Extremities to those of the Capillary Veins with the Blood, and finally follow it even to the Extremities of the Capillary Arteries of the Lungs; from whence it will repass alone into the Vesicles of the Lungs, and from thence into the *Trachea* by which it first came in.

One may make several Reflections, and pretty well founded too, in favour of Monsieur *Mery's* System.

I. One can scarce imagine that the Air which Animals respire, has any other Function rendering it absolutely necessary, besides that of helping the Circulation of the Blood. Now in order to promote that, it seems as if it ought to be in a Mass. We see daily that Air in a Mass contained among the parts of a Water, which is to make a *Jet* or *Cascade*, forces it up higher than it would have risen naturally, and it is certain that the Air intimately mixed with it, that is to say, the same that could be drawn out of it *in Vacuo*, never produces such an effect. It has no other motion but that of the Water with which it is confounded, and it does not communicate to the said Water a new Impulse upon any occasion, that only belongs to the Air which preserves it self always unmixed, and which makes an effort to break thro' its Confinement. What we have here said of Water is of it self applicable to the Blood.

II. If the Air in the Mass is necessary to the Blood for Circulation, it is yet more so to the Blood of the Veins, than of the Arteries; for as we have said in the History of 1700. *The Veins have hardly any Spring in Comparison of the Arteries, and they contain almost half as much more Blood, and consequently have more want of a Foreign Force to help them in Circulating it.* The Air being arrived with the Blood at the extream Parts of the Arteries, must therefore pass into those of the Veins, and consequently it does not get away thro' the Pores of the Skin.

III. If the Air that has been respired enters into the Veins, it can't come out again from the Body of the Animal (tho' it certainly does come out,) but

but by the way that Monsieur *Mery* has Contrived for it.

IV. Since Experience does certainly teach us that there goes out as much Air by *Expiration* as there comes in by *Inspiration*; it is impossible that any part of it can perspire by the Pores of the Skin.

V. As the Air received into the Blood by Respiration does continually strive to break loose from it, and thereby contributes to its Motion, it can't free it self, but when it meets with Passages thro' which the Blood can't follow it. Now it does not meet with any such but when it is arrived by Circulating at the Extremities of the Capillary Arteries of the Lungs. There the Vesicles of the Lungs present themselves, so disposed as to admit of the Air, and to exclude the Blood; and this Effect of their Disposition is incontestable, since they are always full of Air, and that the Capillary Arteries, which are terminated there in an infinite Number almost, discharge none of their Blood into hem, at least if the Lungs be Sound.

Monsieur *Mery* supports his System by three Experiments; if one squirt Water and Milk by the Trunk of the *Vena Cava* into the right Ventricle of the Heart, the Liquor which from this Ventricle discharges it self into the Lungs by the Pulmonary Artery, passes from the Capillary Arteries into the Veins without entring the Vesicles, and consequently the Air, which is intimately mixed with it, takes the same way; which is a sufficient Proof that it is not the Air intimately mixed with the Blood, which being arrived at the Extremities of the Capillary Arteries of the Lungs, that separates it self there.



therefrom, to go into the Vesicles, and to come out by the *Trachea*. Moreover, if one blows Air by the *Trachea* into the Vesicles, it passes from thence into the Veins, and not into the Arteries, for it goes entirely into the left Ventricle of the Heart; a plain Sign that the Arteries which don't admit the entrance of the Air when it is in a Mass, are destined for its coming out, since it must finally come out again, and in the same quantity as it went in. Lastly, If one opens the Belly of a Living Dog, and pricks the *Vena Cava* above the Emulgent Arteries, one sees that in proportion to its discharging the Blood, it is filled with Air, which passes into the right Ventricle of the Heart. It could not have received that Air but by the same Capillary Veins, which it received the Blood it contained, and consequently the Air takes that Course that *Monf. Mery* has described.

His whole System supposes a great Difference between the Air contained in a Mass in any Liquor, and that which is intimately mixed therewith; he conceives that the latter sort of Air is of a Figure adapted to the small Parts of the Liquor, and whilst it continues in that State, has no other Property belonging to it. This Notion might yet require some Explanations, but it is sufficiently establish'd already by other Systems, where it appears necessary; and if one would trace all the Difficulties quite to the end of 'em, each little particular System would lead us to the general Difficulties in *Physicks*.

Upon

Upon the different Kinds of VITRIOLS, and particularly of Ink made with Vitriol.

**I**T is not very Common, and consequently more agreeable, to understand any matter thoroughly, and to see a System supporting itself equally on all sides; that of Mr. Lemery the Son, about his Tree of Mars, may have afforded us one Spectacle of this Philosophical Pleasure; here is another Instance from the same hand. At first the question will only be about common Ink, but that will carry us to much loftier Speculations.

The Solution of *Vitriol* mixed with the Tincture of the Gall-Nut, becomes immediately very black, and that is the *Ink* we use in Writing. Monsieur Lemery conjectures, that as the *Vitriol* of which we make Ink, is nothing but Iron dissolved by an Acid, with which it was intimately mixed, and that on the other hand, the Gall-Nut is an *Alkali* or *Absorbent*; that *Alkali* meeting with the Acids which kept the Iron dissolved, joyned it self to them, and made them loosen their hold upon the Iron, which thereupon revived, and appeared again in its natural Blackness. Thus it is properly, with Iron that we write; but in order to communicate this use to it, it was necessary that it should be first divided into Parts almost infinitely small, as it is in *Vitriol*; and that after having been so subtilly and minutely divided, it should be separated from the Agent that had caused the Division, and which kept it concealed.

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Every thing concurs to establish this Hypothesis of *Monf. Lemery*: Of the five Kinds of *Vitriol*, that which takes its Name from *Cyprus* or *Hungary* is only one, whose Foundation is of Copper; whereas the rest are of Iron; and that *Vitriol* is the only one that does not make Ink. The Spirit of *Vitriol*, mixed with Tincture of Galls cannot make Ink, because it has no longer those Ferrugineous Parts which it kept dissolved. The same Tincture of Galls mixed with Filings of Iron, makes Ink, but not so readily as when it acts upon a Solution of *Vitriol*; because in such a Solution it finds the Iron divided as much as it should be, whereas it is obliged it self to divide that which is the Filings. It makes Ink with the Dissolutions of Iron by the Spirits of Salt, Nitre, Sulphur, Alom and Vinegar, as well as with the Dissolution of Iron by the Spirit of *Vitriol*. If after your Ink is made, you throw into it a few drops of the Spirit of *Vitriol*, the Blackness will disappear, because the Iron does re-unite it self to a new Acid, and becomes *Vitriol* again. By the same Reason Acids will fetch out the Spots of Ink.

If *Alkali's* or *Absorbents*, such as Chalk-Water, Spirit of *Sal Ammoniac*, Oil of Tartar, do not make Ink with *Vitriol* as well as the Tincture of Galls, *Monfieur Lemery* answers, that the former are united to the Acid that keeps the Iron dissolved, but does not separate it from the Iron, as the Gall-Nut does; and why does this latter release the Iron from its Acid? It is because it is Sulphurous, and consequently is more Active, whereas the other *Absorbents* are more Saline and Earthy: And that which proves this Opinion is, that if one animates them by the addition of some Sulphur, they become  
fit



fit for making Ink. Iron was the *Alkali* impregnated with the Acid of Vitriol, and as Iron is always very Sulphurous, another *Alkali* must not be less so, in order to deliver it from the Power of its Acid.

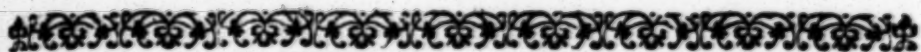
If the Iron when separated from its Acid is not precipitated to the bottom of the Liqueur, as it happens to other Metals, abandon'd by their Dissolvents, the reason is, because it is not so heavy; and besides the Tincture of Galls being Sulphurous, does by its Viscosity bear it up; to confirm which Notion, Monsieur *Lemery* has found that other Matters which suffer'd Iron to sink, would sustain it when any viscous Substance was mixed with it.

Thus you have the whole Mechanism of Ink amply Explained, and curiously Traced even to its smallest Dependencies; from thence Monsieur *Lemery* passes to Observations and Reflections more necessary and profitable.

Vitriol taken inwardly, is of great use in Physick, but it is that of which the Ground is Iron; for if the Copper should predominate, it might be very dangerous. The Blackness which a Solution of Vitriol will receive from Galls, and the different degrees of that Blackness, will make you discover whether it contains Iron, or whether there be any mixture of Copper in it.

Monsieur *Lemery* has found by various Trials that the Vegetables that are reckon'd among astringent Medicines, such as the *Sumac*, the Bark of *Grenada*, the *Balaustes*, &c. are proper as well as Galls to make Ink: That the Purgatives, such as *Senna*, *Manna*, *Jalap*, *Agaric*, &c. make none; and

and lastly, that the Purgatives which like *Rhubarb*, and the *Mirabolans*, bind and strengthen, after having purged can make Ink; from whence there follows a very sure and easie manner of trying the Qualities of a Vegetable, with which one is not acquainted.



*A Second Dissertation upon the Nature of IRON.*

[ See Page 327. ]

IT is good that there should be Disputes sometimes among the Members of the Academy, and may be they happen but too seldom. *The particular Interest one has to support what one has once laid down, animates and warms the Love one bears in general to Truth.*

We have seen in the History of 1704, that from a Mixture of Sulphur, or other inflameable Matter, from a Vitriolick, Salt and from an Earth, *Monf. Geoffroy* has been able to produce Iron. In one of his Operations, Clay furnished him with a vitriolic Acid, as well as with Earth, and Linseed-Oil was instead of Sulphur; in another the Oil of Vitriol provided the Acid, the Oil of Turpentine the Sulphur, and both of 'em the Earth. As he had observed that there are always found some Particles of Iron in the calcin'd Ashes of Plants, he believed that this Metal might also be there formed by the Re-union of the three same Principles; and to assure himself whether this Effect was necessary and infallible, he put the following Question to the Chymists in the Year

1705,

1705, *Whether it was possible to find any Ashes of Plants without Iron?*

Monf. *Lemery*, the Son, was of Opinion that the Iron contained in the Ashes of Plants, was not there formed by Calcination, but that it had really been before in the Plants themselves, and ascended into their Vessels with the Juices of the Earth: That led him to the Discovery of his *Tree of Mars*; mention whereof has been made already both in the History of 1706, and also in that of the present Year.

He still stands by his first Opinion, that all the Matters from whence Monf. *Geoffroy* extracted Iron did really contain it. It is found, and it is not material whether it be in a great or a small Quantity, not only in Clay from whence it is visibly attracted by a Knife touched with a Loadstone; not only in the Oil of Vitriol, which proceeds from a Mineral whose Foundation is Iron; but likewise where one would least have sought for it, in Linseed-Oil, in that of Turpentine, sweet Almonds and Olives; and he relates the Operations, whereby he reduces these Oils to an Earth, in which Iron is found.

Monf. *Geoffroy* answers, that what Method soever is taken to extract Iron from Clay, one shall find infinitely less of it there alone, than when one has mixed it with Linseed-Oil, and that consequently, 'tis the mixture that produces Iron; that as for the several Oils he mentions, it is certain they are not simple Substances, but Bodies compounded of an Earth, an Acid, and of sulphureous and inflameable Parts, which are exactly the three Principles that he requires to the Formation  
of



of Iron; and that according to all Appearances, these three Principles scatter'd throughout the mixed Bodies, are reunited by Monsieur *Lemery's* Operations.

From this Answer of *Monf. Geoffroy*, it follows that the vegetable Matters contain the Principles of Minerals; and he adopts that Consequence, which, tho' Paradoxical, is yet consistent enough with the great Uniformity of Nature. He is likewise obliged not to allow Mercury to be a Principle of Iron; which, however, commonly passes for the Foundation of all Metals. He even hints that it is possible there is nothing of Mercury in any of them; and that Sulphur, Acid and Earth are sufficient. Their different Doses, their Union more or less strong, their different Manners of uniting themselves would solve all. *Monf. Geoffroy* shews by several curious Experiments, that Iron, Copper, Lead and Tinn, divested of their Sulphur and reduced to an Earth, which may be vitrified either by a great Fire or by the Burning-Glass, do resume their metallick Forms, when one restores to them a Sulphur even vegetable. As for Gold and Silver, the Experiments made by the Burning-Glass do sufficiently demonstrate their Sulphur; but when they have been once reduced to an Earth or vitrified, the Chymists have not hitherto been able to bring them back to their former State, by the addition of some new Sulphur; however there is no reason yet to despair of it, and if they could succeed, we should be sure that Mercury does not enter into their Composition, no more than into that of the Imperfect Metals; and that for the artificial Production of the two perfect Metals, one need

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only know what are the Earths proper and peculiar to each one ; since by the union of some Sulphur, they would become a Metal, just as Clay, according to *Monf. Geoffroy*, becomes Iron.

Thus far has this artificial Iron exalted the Notions and Hopes of its Author ; but it must be owned, they are as yet no more than bare Notions and Hopes ; many Difficulties still remain to be surmounted.

To return to the exact Point of the Question that lies between *Monf. Lemery* and *Monf. Geoffroy* : It is pretended by the former, that even tho' the latter should have really made Iron, he could not infer from thence, that the Iron of the Ashes of Plants did not really exist in the Plants ; and that it is only an effect of Calcination : For when one Analyzes Vitriol, one finds Iron in it, but can one say that that Iron is an effect of the Analysis and of the Fire ? Surely no ; since in composing Artificial Vitriol exactly like the Natural, Iron is actually used in it, which is extracted likewise by the Analysis, tho' it disappeared in the Mixture. *Monf. Lemery* promises Answers yet more precise to *Monf. Geoffroy's* System ; but *Answers that one founds upon Facts and Experiments, require a little more time than those that depend upon turns of Ingenuity.*



Upon MUSHROOMS.

**T**HE Moderns, whether by the help of the Microscope, or by a certain exactness in their Enquiries, which is almost as peculiar to them, as the Microscope it self, have discover'd the Seeds of several Plants, which were formerly supposed to have had none, such as, for instance, those of the *Fern*, of the *Polypode*, &c. these Seeds are so small, or so strangely placed, that they are not to be distinguished by the naked Eye, or if they be seen, may be easily mistaken for something else.

We are still in the same Case with the Ancients in relation to *Mushrooms* and some other Plants. What Industry soever has been used, what Hints soever given that the Seed may be conceal'd in some Parts where one does not naturally think to look for them, we have not yet been able to find any of them. The Culture even of Mushrooms might seem to confirm us that they have none. *Monf. Tournefort* has given a very exact, Instructive, and particular Account of them, and it is so much the more Curious, as it augments the Wonderfulness of their Production. In general they spring from the Dunghil, and especially from such as are made with the Excrements of Horses; the Birth of all of 'em may be reduced to that. But what Relation is there between such Dung and Mushrooms? What Vertue has the one to produce the other? One might as well believe with the



Ancients therefore, that the Carcass of an Ox being corrupted produces Bees; that the spinal Marrow of a dead Man, being a good while exposed to a very hot Sun, is turned into a Serpent, &c. for these Metamorphoses so remote and so improbable, are not more so, than that of Horf-dung and Mushrooms.

But we must return to some certain Principles Philosophical and Rigorous, which may set bounds to meer Possibilities, too uncertain and too indefinite. When we consider how complicate the Structure of a Plant is, and how delicately composed, it is wholly unconceivable, that it should result from a fortuitous Concourse of some Juices differently agitated. It is also as little to be conceived that this fortuitous Concourse should at the same time be both so Regular, as always to produce in the same Kind an Infinity of Plants perfectly alike, and so limited, in spite of the infinite extent that Chance ought to have, as never to produce any Kind that had till then been utterly unknown. Besides, as soon as one can perceive the smallest Part of a springing Plant, we see it already quite formed, and are sensible that it does nothing more afterwards but unfold it self and increase; a certain Token that nothing more has happen'd to it from the first instant of its Birth; for could it be the Time wherein we begin to see it, that so suddenly changes the whole manner of Nature's Operation? In short, the Number of Plants that are allowed certainly to have Seeds, and that do spring from thence, is incomparably the greatest, and this is a very strong Philosophical Prejudice in favour of all the rest; or to speak more properly, 'tis much

much more than a Prejudice. If the Ancients had consider'd all these Things, they would not so easily have believed that there are any Plants without Seed.

We should be still less excusable than they, if we should think like 'em ; we I say, to whom the Number of Plants that have no visible Seeds is much smaller. We may then assert without fear, that they all have ; and assure our selves that if our Experience can ever go so far as to unravel the Fact, we shall be justified by it.

But it is most certain, that the Seeds of Plants cannot be disclosed every where ; they must meet with certain Juices, proper to penetrate their Coverings or Skins in the first place, next there must be a Fermentation excited by the said Juices, which is the chief Principle in the unfolding or opening of the little Plant, and last of all those Juices must join themselves, and augment the little parts of the Plants. From thence proceeds the infinite Diversity between the Places that produce and nourish different Plants. There are some that are not produced but upon other particular Plants, of which the Trunk, or the Bark, or the Roots have alone the Juice that is agreeable to them. What Monsieur *Tournefort* has heard from Messieurs *Mery* and *Lemery*, is yet more surprizing : There are a kind of Mushrooms that grow upon the Bands and Plaisters applied to the Wounds and Sores of the Sick-men in the Hospital called *L'Hôtel-Dieu*. After this, no body will wonder that Horse-dung prepared, as Monsr. *Tournefort* mentions, should be a kind of Soil or Bed capable of bringing forth the ordinary Mushrooms.

It follows from thence, that the Seeds of Mushrooms must be scatter'd in a pretty large Quantity in an infinite Number of places where they never appear, and indeed over all the Earth, by Consequence likewise the invisible Seeds of a great Number of other Plants. It must be owned that the Imagination is shocked at first with the Consideration of such a prodigious Multitude of different Seeds, sowed every where indifferently, and in an infinity of places in vain too; and yet when one comes to weigh the Matter, one must allow it. From whence come otherwise the marshy Plants that are found in Lands turned to Fenns and Marshes, and which never appeared therebefore? From whence come those new Plants that other Accidents seem to have produced sometimes in certain places; for instance, the black Poppies that grow in the burnt Grounds in *Languedoc*, in *Provence*, and in the Isles of the *Archipelago*, and which are seen no more the following Years? From whence that great Quantity of *Erysimum latifolium majus glabrum*, which appeared after the Fire of *London* upon more than 200 Acres of Ground where that happen'd, &c? These Kinds of Facts, and many others, which one might alledge equally incontestable, prove at the same Time both the great multitude of Seeds scatter'd every where, and the want of certain Circumstances to make them appear.

This System is so much the more probable; First, because it is now certain that those Plants which were thought to have had no Seeds, are now found some of 'em to have most of all. Secondly, that these little Seeds may be more easily transported



ported into an infinite number of Places by a thousand different Chances. And, Thirdly, By reason of their extream Smallness, they are the better secured from external Injuries, and are longer preserved without any Alteration. One may add, that by the same reason, they are more nice in the Choice of the Juices, by which they are to be unfolded, and stand in need of more particular and uncommon Circumstances.

If to this Speculation upon the invisible Seeds of Plants we joyn that of the invisible Eggs of Insects, which is exactly parallel, the Earth will be found full of an inconceivable number of Vegetables and Animals already perfectly formed and designed in Miniature, and which only stay for certain favourable Accidents to appear in full length; and one may guess, tho' yet very imperfectly, how rich that Hand must be which has sown them all in so great a Profusion.



*Upon the* JUICE *that nourishes* PLANTS.

*B* *Esides the Resemblance that there is between Vegetables and Animals by their Seeds and Eggs, they have still another, and that a pretty perfect one too, by the Liquors and Juices that nourish 'em, and a certain general Plan of Structure is so analogous to each of 'em, that one is almost tempted to think that Vegetables are Animals, wanting only Sensation and voluntary Motion.*

Monf. *Reneaume* has communicated some Observations upon the nourishing Juice of Plants, and particularly concerning the Transpiration thereof. It is above 160 Years that two *Franciscan* Monks began to undeceive the World about the *Manna* of *Calabria*, which was thought to fall from Heaven, and they discover'd it to be a Dew or Moisture that sweated out of the Branches and Leaves of a kind of Ash. When one is once got into the right Way, one goes far in a little Time. We have since discover'd such a great number of Plants that transpire Juices like the *Manna* of *Calabria*, that Monsieur *Tournefort* has cast them into four different Classes. First, Such as contain a great deal of the Essential Salt of Plants; as common *Sugar*, the *Manna* of *Calabria*, that of *Briançon*, &c. Secondly, *Rosins*, as those of the *Pine-tree*. Thirdly, *Gums*, for instance, *Gum-Arabick*. And Fourthly and Lastly, the *Gum-Rosins*. We know that the difference between *Rosins* and *Gums* is, that the *Rosins* are more sulphurous, and the *Gums* more watry; so that the former are dissolved in Spirit of Wine, and the latter in Water. The *Gum-Rosins* are dissolved partly in Spirit of Wine, and partly in Water.

It may happen sometimes that Plants grow weak and perish at last by a too great Transpiration of their nourishing Juice, as Animals by too frequent and too abundant Sweatings. It is thus, according to Monf. *Reneaume*'s Observation, that the *Nut-trees* in *Dauphiny* commonly die, after they are over-charged with a kind of *Manna* which they yield; and for that reason, the People of the Country are afraid of seeing it come out in too great a

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Quantity. Not, but that that Tree has a great deal of the nourishing Juice; *Monf. Reneaume* proves it by a remarkable Fact; but both the close Texture of its Bark and Leaves, and the great Quantity of a very fleshy Fruit which it is to feed, seem to demonstrate that Nature did not intend that much of its Sap should be so unprofitably spent by Transpiration.

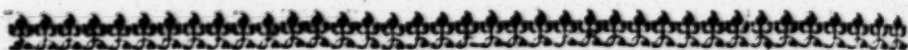
There is another Way by which Plants lose their nourishing Juice, at least with respect to us and our uses: It is by diverting it into young Branches, in Moss at the Roots of Plants, in useless Branches, or in so great a Quantity of Fruits, that in a few Years they are exhausted and bear no more. The Art of Agriculture has found the Remedies or the necessary Precautions against it. It is to prevent both these Evils at once that they cut the Vines.

It has been already observed, and *Monf. Reneaume* confirms the same, that the Root is the Stomach of the Plant, and makes the first and chief Preparation of the Juice; from thence it passes, at least for the greatest part, into the Vessels of the Bark, and there receives a new Digestion. The hollow and rotten Trees, whose Trunk has no more Wood in it than what is just sufficient to support the Bark, and which yet live and produce, do sufficiently prove how much more important the Bark is than the woody Parts: The Leaves contribute to the Perfection of the nourishing Juice, as we see by the Trees whose Leaves have been eaten by Caterpillars, and which, tho' they had blossomed, bore no Fruit the same Year, or none but wither'd. The Action of the Air, or of the  
Nitre



Nitre of the Air, or of the Dew upon the Leaves is very sensible, by the Difference of the Colour and Taste that is between Plants growing in the Air, and those that are not so.

Such are the Principles of which *Monf. Re-neauime* makes more particular Applications in his Discourse. *The Detail of Agriculture is of it self very agreeable, and as all Mankind was naturally designed to that Employment, it seems that those who have not the Practical part, ought at least to Study the Theory thereof with much pleasure.*



### Upon THUNDER.

**H**ere are Chymical Operations performed in the Air as well as in our Laboratories, and sometimes they are the same. *Thunder* is nothing but that Inflammation of which we have spoken in the History of 1701, occasion'd by the mixture of a Sulphurious Matter with an Acid Spirit; but the Conformity even of these two Phenomenons may cause a Difficulty.

The two proper Matters mix'd together by a Chymist, when they are once inflamed, are entirely dissipated, and there cannot be a new Inflammation without new Matter. But we often see a great Number of Lightnings one after another proceeding out of the same Cloud, which denote as many different Inflammations; but how comes it to pass that when the inflamable Matter in the Cloud is kindled, there happen new Inflammations?

Monf.

Monf. *Homborg* thinks that the same Matters which take fire by their Union, and thereupon are immediately separated, may be joined again and re-inflamed, and that it may so happen several times after one another. But that it cannot be so upon the Earth, because as soon as they are kindled, and consequently very much rarified, the lower Air more heavy than they, pressing upon them from all Parts, raises them up into another Region, where they find themselves in an Equilibrium with a finer Air, and so are quite lost as to us. But if these same Matters are raised in Vapours from the Body of the Earth by the Action of Heat, they are arrived at that Region of the Equilibrium, where they are kindled, and meeting with no Air more heavy than themselves, which after their Inflammation might cause them to ascend, they are not dispersed at all, but remain where they were, and may be joined again, till a Shower of Rain beats them down upon the Earth, and cleanses the Air of them.

This Solution is so much the more probable, as it is founded upon the self-same Operation by which Thunder is represented. If instead of pouring Spirit of Nitre as quick as you can upon essential Oil, which produces a sudden Inflammation, one pours it drop by drop, there is only produced an Effervescence without Inflammation, and the mixture of the two Liquors becomes a Rosin, which being put into a Glass, and distill'd by degrees, renders the Acid and the Oil, of which it was formed. This Acid and Oil are still capable either to be inflamed by their Union, or of producing a new Rosin, which will undergo the same Operation as  
often

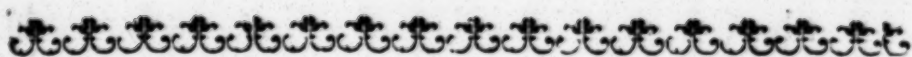
often as you please. The Fire of the Distillation does here make the same Separation of the Matters as the Flame would have done, if you had suffer'd them to kindle ; and consequently it appears, that if they did not escape us, they might as well produce a new Flame as a new Rosin by their Reunion.

As at every instant, when a Flash of Lightning strikes our Eyes, there is a pretty large Quantity of Matter inflamed, it may happen according to *Monf. Homberg*, that all these repeated Inflammations may give a certain determination of motion to the Air, and produce some of the variable Winds that arise indifferently from all the Points of the Horizon, and are the only ones we know in our Temperate Climates.

From thence it is perhaps that we have more South than North Winds, there being always much Thunder between the Tropicks. This is certain, that this Notion does pretty well explain why our Winds blow by snatches, the Lightnings follow one another pretty close, and each makes a distinct Effort. If we were sure that the Trade-winds blew more continued, it would be a Confirmation of this Hypothesis.







*Upon a W O R M that came out of the N O S E.*



Woman of a very good Constitution, and who never knew what it was to have the Head-ach, about the Age of 36 began to feel a settled Pain at the lower-part of her Forehead, on the right side near the Nose : This Pain, which at first took up but a small space, extended it self by little and little as far as the Temples on the same side ; and whereas at first it had great Intermissions, at the end of two Years, it became almost Continual, being attended with Convulsions, and almost perpetual Wakings ; and at last it was so violent that the Patient was 2 or 3 times at Death's Door, and quite deprived of Sense in the great Fits. At the end of four Years, and after having try'd all sorts of Remedies in vain, she left them off, contenting her self with a regular Course of Life, and taking Snuff by the Nose, which she hoped would give her some Ease.

She had not used it above a Month, when one Morning, sneezing pretty strongly, she voided by her Nose a Worm, rolled up in a Ball, together with a little Blood : She was very much frightened at it, and cured the same Moment. At once she perceived that long and cruel Pain to cease, and the only Token that remained of it was, her Nose bled for 2 or 3 Days together. Her Mind was likewise as free as it had been before her Illness. *Monf. Littres*, to whom we are beholden for this Account, took care to be exactly informed of all these Facts as well as of the following. The

The Worm was alive, and was six Inches long when he stretched himself out as long as he could, and but only two when he folded himself up *en zig-zag*, or in the Figure in which the Soldiers make Trenches before a Town they Besiege, which was his most usual Figure : He was two Lines in breadth, and one and a half in thickness in the biggest part of his Body, which was towards the Middle : His Colour was of clear Coffee ; he was convex above and flat below, cover'd throughout, except at the Head, with annular or ringy Scales of the largeness of a Line, and all of them separated from each other by little Intervals, from each of which there came out as well on the right as on the left side 56 Legs of the length of a Line, and of the bigness of a Hair of one's Head : By which it appears, that this Worm was of the Kind of those we call *Centipedes*. The Head was of about the Length of two Lines ; one might easily distinguish in it two Eyes, two Horns, a Pincher made of two Branches that were more remote from each other at the Root than towards their Extremity, and a Mouth between these two Branches ; the Tail was armed with two kinds of equal Stings longer and bigger than the Legs ; it was put into a little empty Glass Bottle, where it was found alive 18 Hours afterwards ; then they poured some Brandy upon it, notwithstanding which it still lived 2 or 3 Hours.

The Seat of the fixed Pain which the Woman felt, sufficiently denotes that the Worm must have been in a Cavity called *Sinus Frontalis*, which is in the *Os Coronale* under the Eye-brow ; that Cavity is about 2 Inches long, and between 8 and 10 Lines

Lined in Breadth, and consequently able to contain the Animal as it was rolled up. It seems by the inclination he had to resume such a Figure that he must have been accustomed to it.

There is between the *Sinus Frontalis* and the Nostril a Hole of Communication, by which the said *Sinus* receives Air every moment one respire, and a strong Respiration might have sucked in with the Air the invisible Egg in which this Worm was inclosed: The same Egg might likewise have entered by the Mouth with some Food, and followed the long and winding Road of the Circulation of the Blood; but however, it is certain that the Animal could come out no other way but by the Passage before-mentioned. It is true the Diameter thereof was lesser than that of the Body of the Animal; but as this Hole is immediately formed by a Membrane, he might dilate it by little and little, when he attempted to get out, and the drops of Blood that followed do even shew that he tore it a little.

The Egg had found in the *Sinus Frontalis* the Heat, Moisture, Lymphæ, in a word, every thing that was necessary for Hatching it; and the Animal every thing he wanted for his Substance, and for such an Increase to which probably he would not have attained if he had been upon the Earth, where he would neither have been so well fed, nor secured from abundance of Accidents, which hardly allow four Years Life to all these sorts of Worms. At every motion it made, it must have occasioned, in the delicate Membrane that lines the *Sinus Frontalis*, an Irritation so much the more dreadful, as with his 2 Horns, and his 2 Stings



Stings, and his 112 Legs, it shook, and, as I may say, assaulted in particular each little nervous Fibre of the Membrane; and the stronger and bigger the the Worm grew, the more violent and insupportable must have been the Pain. The bigness of the Animal, which made his Lodging so inconvenient for him, and probably too the smell of the Snuff, which was disagreeable to him, as it is to a great number of other Insects, made him seek for Means of getting out.

The Symptoms which the Patient had, might pretty easily cause the like Accident to be discover'd, in which case, Monsieur *Littre* is of opinion, that the Inflammation of the Membrane abovemention'd must be forthwith prevented by the ordinary Means that are used in Inflammations; the next thing to be done is to come at the Worm, which one may do both by the Internal Medicines that are used against Worms, and at the same time by External Remedies, since the Worm was within their reach too. One may already presume that Tobacco is good, but besides that, People may strongly draw in at the Nose sharp or acid Juices, such as may be found most capable of disturbing the Animal. Monsieur *Littre* believes that nothing would sooner kill it than Oil, because that is known to deprive Insects of Respiration, by stopping all the Orifices of their *Trachea's*.

*Lastly*, If none of these ways succeed one must come to a Chirurgical Operation, which he assures us would neither be dangerous nor difficult upon the *Os Coronale*. *What Disorders does an Atome cause in the Machine of the Humane Body! even to the overturning of our Reason it self.*

Upon

*Upon the Cures made by BURNINGS.*

**H**ERE is another instance of violent Head-achs, which have been as suddenly and unexpectedly cured. A Lady of 35 Years, and of a good Constitution, was troubled with continual Head-achs, with Redoublements that seized her regularly one in 8 or 10 Days, and lasted 10 or 12 Hours at a time, so violently, that she was sometimes quite stupified with them, and sometimes raving Mad. The Seat of the Pain was chiefly in the fore-part of the Head, and in the Eyes, which thereupon became very red, and sparkling. The great Fits were attended with Retchings, and always ended in Vomiting abundance of a white insipid Matter, and a green and very bitter Water, which came last of all. At those times she could take no kind of Food, otherwise her Stomach was very good, nor did she grow Lean, notwithstanding the long continuance of so uneasy a Condition.

Monfieur *Homberg* made use of all sort of Remedies for the space of three Years, but in vain. Opium alone did for some Hours suspend the ordinary Pains of her Head, but had no effect upon the Redoublements.

One Evening when she felt one of those Fits coming upon her as she was going to Bed, she had a mind to see first whether her Eyes were very red, and whilst she looked in a little Pocket Glass, a Wax-Candle that she held in her Hand fired her

A a

Night-

Night-Cloaths that were of thick Muslin; she did not perceive it immediately, and happen'd to be all alone. She burnt all her Forehead, and part of the Top of her Head before any Body could come to her Assistance. Monsieur *Homberg*, who was presently sent for, caused her to be Blooded that instant, and the Burn to be dressed as in like Cases, the Pain whereof was stopp'd in a few Hours, but the great Fit, which she expected, came not at all; even the ordinary Pain disappeared almost immediately after, without any other Remedy than the Burn; and for these four Years, since that happy Accident besel her, the Lady enjoys perfect Health.

A Physician of *Bruges* has communicated to Monsieur *Homberg* a like Account, of which he himself was Witness. A Woman, who for several Years had had extraordinary Swellings and Pains in her Legs, found Ease by Bathing them with Brandy every Morning and Evening by a Fire; one time the Fire by chance got hold of the Brandy with which she had rubbed her self, and burnt her slightly. She applyed some Ointment to the Burn, and during the Night all the Waters with which her Legs and Thighs had been extreamly swelled, were entirely evacuated by Urine, and the Swelling returned no more. *What pity it is that such Accidents do not oftner intervene in the Practice of Physick?*

'Twas Chance, without doubt, that has taught this kind of Remedy to several barbarous Nations that use it with Success, and perhaps more chearfully as it is more Cruel, and affords them more Occasions of shewing their Courage.

Monsieur



*Upon the Cures made by BURNINGS.* 365

Monfieur *Homberg*, who was Born in the Island of *Java*, remembers that when the People of that Country are troubled with a certain Cholic, or with Belly-achs, and Fluxes that are usually mortal, they cure themselves by Burning the Soles of their Feet with a hot Iron. If they have a *Panaris* on their Fingers, they dip the Finger that is affected in boiling Water feveral times, an Instant at each time; and Monfieur *Homberg* himfelf, to follow in fomething the Custom of his Country, was cured of a *Panaris* after the fame manner. In the Relations of Travellers, we find a great many other Diftempers, which the Savages cure by Burnings; and without going fo far, we our felves upon many occafions apply the like Remedy to *Horfes*; *Hunting-Dogs*, *Birds of Prey*, &c. But it is likewife true, that our own Niceneſs and Tenderneſs does not ſuffer us to uſe it upon our felves, and makes us perhaps prefer long Pains to ſhort ones.

The ſame Tenderneſs would not ſuffer us a long time to uſe in *Europe* that *Moxa* or *Mofs*, that the *Spaniards* brought from *America*, and where-with they cured the Gout by Burning it upon the Part affected. However, Monfieur *Homberg* has ſeen an Inhabitant of *Hamburg*, who by this Remedy was delivered from his Fits of the Gout in 7 or 8 Days time, which before laſted 2 or 3 Months, and they returned much ſeldomer upon him afterwards.

Monfieur *Homberg* ſuppoſes that Burnings cure in three manners; either by putting the Noxious Humours into a very rapid Motion, which makes them find out new Ways; or by rendring them Fluid that before were Viſcous, which comes to

the same effect; or, lastly, by destroying part of the Vessels which brought them in too great an abundance.



### *Upon the Generation of SNAILS.*



*THE Philosophers that are reproached of Studying with too much Care and Application the Nature of such contemptible Animals as Insects, may defend themselves by only asking this Question: Whether the smallest Works that come out of the Hands of God deserve to be neglected? But these same Works which the Common sort of Mankind are pleased to look upon as the smallest, are even those in which we discover the greatest Wonders of Mechanism; and if we henceforwards prefer the Enquiries made into the Anatomy of Humane Bodies, it is our Interest alone that can bear us out in doing it.*

If one examines externally a *Brown Snail* of the Gardens out of the time of its Copulation, and if one dissects it with all the Care imaginable, one shall not find in it any part that seems to belong to Generation. Nevertheless, as we have already said in the History of 1699, this Animal is an Hermaphrodite, and has consequently, with relation to Engendring, a greater Apparatus of Organs than a vast number of other Animals, more known and more studied. Every thing that happens to him upon this occasion, must likewise be of a very par-

particular Nature. We shall here give an Account of the Chief of these Singularities, without undertaking in any manner to explain by what Mechanism they are performed. This Explanation would be useless, if any of the Circumstances should be omitted that are in the Dissertation of Monsieur du Verney, which the Author's Sickness has hitherto hinder'd from appearing. *One can hardly see without Amazement, to what an expence Nature is put in the Formation of this contemptible Animal.*

This kind of Snail has on the right side of the Neck a little Cleft or Hole, almost imperceptible, which only leads to little Conduits or Cavities, and a sort of very winding Intestines floating in its Belly: At the time of Coition all that changes its Form, and the Animal becomes almost metamorphosed. These Intestines are then thrust from the bottom of the Belly towards the Neck, where they swell, and are turned and winded, and finally disposed and ranged among themselves in such a manner, to approach the Cleft of the Neck, which is then very much dilated under the Figure of a Male and Female Part, each of them ready to perform their Functions; that does not wholly happen till after that one Snail has met another, and by several Preliminary Motions more brisk, and, as one may say, more passionate than one should expect in such a Cold Species of Creatures, they have put each other into the same Disposition, and have secured a perfect Agreement.

They have likewise another very singular way of arriving at their Ends with more Certainty, and they never fail to put it in Practice. Together



with the Male and Female Part there comes out likewise by the Hole above-mentioned, a kind of a Sting like a Lance with 4 Beards, and ending in a very sharp and hard Point. As the Snails turn towards each other the Hole or Cleft of their Neck, it happens that when they are touched in that Part, the Stings prick each other, and the Mechanism that puts this little Dart in Motion, is such, that it abandons at the same time the Part to which it is fastened; so that the said Sting either falls to the Ground, or the Snail that is pricked carries it away. Then the Snail immediately retires, but presently after he rejoins the other, and pricks him in his turn; and after this Reciprocal Wounding, the Coition never fails to be accomplished; whereas all the other Preludes may be without Consequence. The Sting bearded on both sides, seems to be designed to give notice to both the Snails that they are equally ready; for in this Hermaphroditical Species there is not, as in ours, one Principal and more active Sex, whose Disposition alone is sufficient.

The Snails are wont to couple even 3 times, the space of 15 Days being interposed between each time. At each Coition one sees a new Sting, and Nature is at the Pains of producing them for a use so little important in Appearance. *Monf. du Verney* compares this Regeneration with that of the Horns of Stags, and really, the Proportions being observed, these Stings seem to be of a like kind of Substance.

After the Lanced Sting, follows the Reciprocal Insertion of the Male-part of each Snail; and as they have both the two Organs of Generation disposed in

in the same manner at the Cleft of the Neck, it will be necessary, to the end that each Organ answer to that which does not resemble it, that one of the Snails hold its Head upwards, and the other down, which they know very well how to put in Practice.

Their Coition lasts 10 or 12 Hours: It produces in them, especially when it begins, either a Stupification or a Transport that hinders 'em from giving any Sign of Life. They will not part from each other, do what you can, and they have a very good reason for it, which is, the Gland of the Male-part swells to such a degree, that it can't come out again by the part it enter'd. It is perhaps an Hour in acquiring this Extension, which it does *Gradatim* but till it attain'd to it, no seminal Matter is ejected.

Nay, such Matter is not so much as form'd till then, and it is not till after the Coition is begun, that Nature thinks, as I may say, of preparing it, and that she sets those Parts at Work that are to provide it. This Matter has yet another Particularity very remarkable, it is not *Liquid*, but of the Consistence of Wax, and puts on the Figure of the Vessels thro' which it passes; it is protracted by a Motion like that of the Intestines, when they throw out that which is contained in them. During the whole time of Coition, except the first Hour, this Matter passes slowly on both sides from one Snail to the other.

It comes out of Channels longer than the Vessel of the Female-Part, where it is immediately receiv'd, and for that reason it is forced to double itself; from thence it passes into other Vessels of

Female Sex, where it finally causes Fœcundity, tho' not immediately after the first or second Coition, but only after the third.

At the end of 18 Days the Snails lay their Eggs by the Cleft or Orifice of their Neck, which they hide in the Ground with great Care and Pains; but there is yet another very singular thing, which is, if you Dissect a Snail a little while before she lays, you meet with no Eggs, but only with little Embrio's swimming in a very clear Liquor, and moving very briskly. These Embrio's become Eggs in the way of their coming out, that is to say, they are cloath'd with Membranes, which certain Liquors supply them with, and then grow hard.

*All this is only the Natural History of the Generation of Snails; 'tis what is done, but not the manner of doing; and if one leaves this manner to the Conjecture of the most skilful Philosophers, it would assuredly be a very difficult Riddle to them. It is even still almost inscrutable, tho' we have all the Parts of this Mechanism in our Hands, tho' we see with our Eyes how it is perform'd, and it is one of the greatest Efforts of Humane Sagacity and Understanding to comprehend the whole Operation thereof.*





*Upon the Weight of the ATMOSPHERE.*

THE *Weight of the Atmosphere* is of such Importance in Philosophy, that it cannot be too much studied; we are even invited to it by the hope of the Success which seems only to depend upon some pretty easie Calculations.

Monfieur *de la Hire* having made at *Meudon* some very nice Experiments, how much the height of the Barometer differ'd from the highest Part of the Park down to the River, which is 85 and  $\frac{1}{2}$  Fathoms at the Bottom, he deducted from it the Height of the Column of Air, which was then equal to one Line of the Mercury, and counter-balanced it, and found that it was very near 76 Foot; the Weight of the whole Column of the Atmosphere being 28 Inches of Mercury within half a Line. He made use of a very good double Barometer of Monfieur *Huygens*, which shews the Degrees of the Variation in a much greater Extent than the single Barometer; but it likewise requires more Calculating, because it must be reduced to the Single, and he reduced it thereto according to the Principles we have explained after him in the History of 1708.

It is necessary to observe, that the whole Height of the 85 and  $\frac{1}{2}$  Fathoms were pretty near equal to 7 Lines of Mercury, and that the 76 Feet of the Height of the Air, which answer to one Line of Mercury, were found, by supposing the 7 Heights of

of Air, each of which answer one Line of Mercury, to be equal among themselves, which is not exactly true; for the lower is the lesser, because it is loaden with a greater Weight, and is more condensed, and so of the rest; but Monsieur *de la Hire* has slighted this Difference: Messieurs *Cassini* and *Maraldi*, having a regard to it, have placed between these Heighths a Progression, so that the first having 61 Feet, the second had 62, the third 63, &c. at least in the Extent of half a League; after this, reckoning the middle Heighth of these 7 Divisions would be 64 Feet, which is a great way off of 76. We must not conceal these Differences, which perhaps may be accommodated in time.

With his Observations upon the Weight of the Atmosphere, Monsieur *de la Hire* has joyned others, concerning the Variation that Heat and Cold produce in the Liquor of the double Barometer, a Deceitful Variation, and which, if it were not well known, might be attributed to the Alteration of the Weight of the Air. He supposes, as it is true, that the Mercury in the single Barometer is not sensibly rarified nor condensed either by Heat or Cold; he compared it every Day for three Years together with a double Barometer, and afterwards took the most differing Days with respect to Heat and Cold, in which, however, the single Barometer was at the same Heighth: It is plain, that on those Days the height of the double Barometer ought to have been the same, if it did not vary but with the weight of the Atmosphere: But it was always different, and sometimes 19 Lines, which this Barometer was higher in the Heat. It happen'd in those three Years of Observation, that there were no great Colds

Gold but only great Heats. Besides, there were not Days of greater Heat and of greater Cold, on which the single Barometer was of the same Heighth; so the 19 Lines are the Difference only between a great Heat and a temperate Air; and Monsieur *de la Hire* could not see the greatest Variation of which the double Barometer was susceptible in that respect. It ought much to exceed 19 Lines, which certainly is not to be reckon'd for nothing. Nevertheless the Liquor of this Barometer was chosen for the least capable of Rarefaction as could be.



Upon the Matter, or Substance of FIRE.

THE History of the Academy for the Year 1700, speaking of Lime, says; We cannot suppose its Active Principles to be any other thing but Particles of Fire, which the Calcination has introduced into the Lime. It is true, that these Igneous Particles being become fixed and immoveable in the Pores of a Body, do a little shock the Understanding; but however, the Regulus of Antimony Calcined by the Burning-Glass does actually increase in Weight, and one cannot suspect any other Substance to have been mixed with it, but that of which the Rays of the Sun are composed. It must be confessed that this Hypothesis is equally difficult to be admitted or rejected.

Monf.



Monsieur Lemery the Son, is of an Opinion that one need not remain under this Uncertainty, and absolutely declares for the above Hypothesis. It has been believed hitherto that the Essence of the Matter of Fire consists only in a great Subtility, joyned to an extream Agitation, and, according to that Notion, it is impossible to conceive that when it is shut up in the Pores of Lime, or *Regulus of Antimony*, or in short, of any other Mineral, whose Weight is augmented by Calcination, it should not lose all its Motion, and cease to be what it was before, the Matter and Substance of Fire. But Monsieur Lemery adds to its Subtility and Agitation a peculiar Figure, so that, neither another Substance, tho' it had as much or more Subtility and Agitation, could be the Matter of Fire, nor the other cease to be so; or it would at least be altogether disposed to become Fire again, tho' it might have lost part of its Motion. It is true, it must not lose it altogether; and in order to preserve as much Motion as is necessary for it, one may conceive that it both acts and always strives to force its way out of the little Cavities of the Bodies in which it is imprison'd; and also that another Matter, much more subtile or fine and more agitated, which fills all the void Spaces of the Universe, and finds no Pores so narrow as not to allow it a free Passage, does incessantly flow into those Places where the Substance of Fire is shut up, and maintains its Activity and Motion: It has not indeed sufficient to force its Prisons, but is always in a Condition to joyn its own Strength to that of some External Agent coming to its Assistance. Thus it is, that

when

when one pours Water upon Lime, whereby its Parts are opened and separated, the Matter of Fire inclosed therein breaks out on all Sides, and causes a violent Effervescence.

If it should be asked, why this Matter, which, Calcination has introduced into the Pores of a Body, does not afterwards come out by the same? Mons. Lemery answers, that the Action of the Fire rarifying all Bodies, as is known by Experience, it makes, as long as it lasts, their Pores much bigger; and when it ceases, it suffers them to be contracted again, and consequently to imprison in its little Cavities all that had penetrated into them.

*There is nothing alone, or singular in Nature, and if a certain Mechanism be constant and uniform upon certain Occasions, it will likewise be found to be the same upon other Occasions that may be analogous to them.* Since therefore it is once admitted that Fire can, without ceasing to be what it was before, shut it self up in the Cavities of Calcin'd Bodies; we have a right to suppose that it may have been in like manner shut up in the Cavities of several other Bodies, as soon as we see that it comes out of them; and in a word, one may lawfully suppose that it is that same Substance that renders inflameable all Bodies that are so, and that it escapes under the form of Flame as soon as it can disentangle it self, especially if there be but enough of it. The Sequel of Monsieur Lemery's System extends it infinitely.

At this reckoning the Substance of Fire and that of Water, tho' so very opposite, have an essential Relation; both the one and the other of 'em being hid

hid under an Infinity of Mixtures, and oftentimes even in great Abundance, nevertheless without discovering therein any of their most sensible Properties, and without declaring themselves for what they are, unless some external Agents assist in the exerting them.

The *Phosphores* are those of all the Bodies in which the Matter of Fire is most visibly inclosed: One need only expose them to the Light, and they presently receive some new Matter that puts the Old into Action: We may call 'em *the Sponges of Light*, because it is squeezed out of 'em with the same Facility as it is taken in. You must conceive all inflammable Bodies to be like *Phosphores*, only less sensible, and not so readily restoring that Substance of Fire which is contained in them.

The Air likewise may be esteemed a great *Phosphore*, all impregnated with the same Matter, and only waiting for the Action of the Sun from whence it is derived. But we will not carry any farther Notions that should belong to a general System; we refer to Monsieur *Lemery's* Dissertation, who must likewise be accountable for all those Difficulties, which general Systems never fail to abound with.





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Upon CRABS-EYES, &c.

**W**Hat they call *Crabs-Eyes*, are little white Stones, round, and commonly flat; and they are so called, because they are really taken out of Crabs and Craw-fishes; and tho' they are not at all like Eyes, yet they are more like them than any other Part. The most Learned Naturalists believed they were formed in the Brain of Craw-fishes, and *Van Helmont* first discover'd them to be in the Region of the Stomach; besides several other very remarkable Particularities of the Natural History of these Creatures. But as there is not much Credit due to him, what he says, has not been much minded; nevertheless, *Monf. Geoffroy* the Younger, has verified a great part of it, in a Discourse of which the following Account is an Abstract.

There are a sort of Animals that wear their Bones on the out-side, whereas others wear theirs within; of the first sort are the Craw-fishes, which every Year, about the Month of *June*, cast those Bones, which are both their Coat and Armour. A Membrane that lines the inside of their Shells supplies the place, and by growing hard and thick becomes a new Shell. At the Time of this Molt-ing, that Fish is weak and languishing, and not good to eat.

The Reptils or creeping Creatures that shed their old Skin, are an Example of that which happens to the Craw-fishes; and in short it is no such strange Thing

Thing that an Animal should be divested of its external Coverings. But it is very amazing that an Animal can quit or deprive it self of an internal Part, such as the Stomach : And yet this is the Case of the Craw-fishes. Their old Stomach disappears, and probably the Intestine also ; at least *Monf. Geoffroy* is of that Opinion, and that the external Membranes of those Bowels succeeded. There is reason to believe, that as they are worn out and half dissolved, the total Dissolution of 'em is performed in the new Bowels, and they are converted into the Nourishment of the Animal, during its Molting and Sicknes. Thus the old Stomach is the first Food that the new one digests.

'Tis only at this Time that are found the Stones they call *Crabs-Eyes* ; they begin to be formed when the Old Stomach is destroyed, and are afterwards folded up in the New, where they always diminish in bigness, till at last they quite disappear. *Monf. Geoffroy* is of opinion, that they likewise contribute to the Nourishment of the Animal during its Sicknes. What a prodigious Diversity of Designs in the Works of Nature ! Who could have thought that there is an Animal which feeds upon the substance of its own Stomach ? After this, if there be any thing incredible in this Kind, it must be an Impossibility well Demonstrated.



Upon the Formation of SHELLS.

Hitherto the Curious have been chiefly concern'd with Shells; that is to say, with their prodigious Variety, exact Regularity of their Structure, Beauty, singular Vivacity of their Colours, and Justness of their Compartments, scarce imitable by the best Pencil; but the Philosophers have not done them, as I may say, all the Right they ought, and have too much neglected to consider them as Naturalists, and to Study their Formation; probably they believed that since the Shells of Snails, &c. as well as the Armour of Crabs and Lobsters, are external Bones to all the Animals they cover, they ought to be look'd upon as part of their Bodies, and that this wonderful Structure is included in that of the general Formation of Animals, not to be comprehended by the Mind of Man; they have therefore supposed that the Animal and its Shell sprang from the same Egg, and were unfolded together; and they contented themselves with wondering that Nature had bestowed upon 'em Houses so well built, and oftentimes so precious for such base Creatures. But this Supposition is only convenient, and tho' probable enough, is by no means true. The Animal proceeds from its Egg, but not the Shell, which is a distinct Miracle, and Monsieur *Reaumur* is the first that has unravelled it; at least we know not hitherto any other Author that can dispute with him the Glory of this Discovery.



He has found out, by decisive Experiences, that the Shell of Garden-Snails is formed of the Matter transpired from their Bodies, and afterwards harden'd by the Air. It is certain that all the other Animals do likewise transpire, and are surrounded with a kind of Mist or Atmosphere, which is exhaled from them, and which perhaps does pretty near assume their external Figure. All that the Snails have in particular is, that the Atmosphere of their Transpiration is condensed about them, and forms a visible Covering of which their Body is the Mold; whereas what other Animals perspire, evaporates, and is lost in the Air. This difference proceeds from the different Substance transpired, that which comes out of the Snails is viscous and stony. This is not a bare Supposition; it is a Fact sufficiently proved by *Monf. Reaumur's* own Experience.

At this Reckoning, tho' the Shell performs the Office of an Universal Bone to the Animal; yet it does not grow like the Bones, nor as other Parts by Vegetation, that is to say by a Juice that circulates within it; but only by an External addition of Parts that come over one another, after the same manner as Stones are thought to grow; and it is remarkable that there are a kind of Animals that borrow from Minerals this way of Augmentation.

To enter a little farther into the detail of the Matter, it must be remember'd that the Head of the Snail is always at the Orifice or opening of the Shell; and that its Tail, or the other extream part of its Body, lies towards the point or top of the Shell; and that its Body from what Cause soever

it proceeds is naturally of a Spiral Figure, of which the different Turns are in different Planes. This being supposed, Let us take a Snail that is just hatched, and is as small as can be : Since the Matter which it transpires is petrified about it, there will be made at first a little Case proportion'd to the size of its Body ; and whereas its Body is as yet too small to make a spiral Turn or at least an entire Figure of that kind, this Case would only be the Center, or at most, the first beginning of an exceeding small spiral Turn. Then the little Creature grows, but if it should cease to Transpire, it is plain that its Body, as far as it was enlarged, would remain naked ; but as it never ceases to transpire, it makes it self a Covering in Proportion as it grows ; it puts it self at the end of the first, and if it grows so far as to make a second spiral Turn, the Shell likewise makes a second. This second Turn is the second, or which is the same thing, the Spiral is extended in length, because the Animal grows so too, and at the same time this Turn is likewise larger than the first, or of a greater Diameter, because the Animal is likewise increased in bigness. The other Turns are formed after the same manner : They proceed in the Shells of Garden-Snails as far as four Turns and a half.

It is a necessary Consequence of this Formation of the Shells, that the first Turns of that of a young Snail, which for instance, may have had yet but two, should be no bigger than the two first Turns of a Shell of an older Snail which has four ; for that which is once formed in the Shell does increase no more, only there is added in time

a new Shell to it. And this is what is unchangeably observed; so that nothing more is required to demonstrate *Monf. Reaumur's* System: And what still confirms it is, that these first Spiral Turns, which in the Shell of a young Snail are as long and as large as in that of an older, are notwithstanding less thick. We may see by that, that the Part of the Animal, which would have remained naked, by its growing bigger is, as it has been said, that which has laboured to cover it self; and that those Parts which were already cover'd by continuing to transpire, do augment the thickness of their Covering.

Let us descend a little farther into the Particularities of this Creature. We see Spiral Rays traced upon the Shells of Snails, chiefly upon those of a certain kind of little Garden-Snails; the Ground whereof is commonly Yellow, or Lemon-colour with black or dark Rays.

*Monf. Reaumur* explains those Rays after the following manner: That which is called the *Collar*, or Neck of the Snail, is the principal Worker of the Shell; because when the Snail grows, the Collar always remains uncover'd. If you suppose it to be yellow, with one only black Spot, or to speak more exactly, that the Matter that transpires from the whole Collar is of such a Nature as to make the Shell yellow, excepting so much as comes out of one only Pore or Point, and which will make the Shell black; it is plain (provided you represent to your self the Animal growing ever since its smallest Size, always turning it self spirally, and augmenting the Number of Turns) that the black Point of the Collar will trace upon  
the



the whole Shell a black Ray, which will be a Spiral very exactly described according to the insensible and regular Growth of the Animal. If the black Point was not a Point, but a right Ray, the Spiral of the Shell would be less Curve, but it would always be regularly described. If there were upon the Collar several Points, or several Rays of the same or of different Colours, there would likewise be upon the Shell several Spiral Rays, either of different Colours, or of the same, and the Position they would have between themselves would depend on that of the Points or Rays of the Collar.

It must not be thought that these Points or Rays of the Collar are a meer Supposition, they are distinctly seen ; and besides, they are always observed to be ranged under the Extremity of the Spiral, which they must have traced upon the Shell ; the part of the Snail that comes next to the Collar yields nothing but a white and shining Matter ; and as it is that, which as long as the Snail grows, succeeds the Collar, and always places it self under the part of the Shell that it has formed, it tinges the whole internal Surface of the Shell with a shining white, and from thence it comes that the said Surface either has not the same Colour as the External, or else has no variety of Colours.

There is no Naturalist that cannot of himself apply what has been here said of the Shells of Snails to those of all the other Animals that are so covered. The Varieties that we have already imagined in the Collar, with respect to the colour, number and position of its Points or Rays, may

help us to fancy a great many other of different Kinds. For instance, if there are little Eminencies disposed upon the external Surface of the Animal, the like will be produced upon the Shell, which will always be regularly augmented in Proportion as the Collar and its Eminences increase. If the Animal ceases to grow at certain regulated Seasons that are contrary to it, as in Winter or Summer, and afterwards begins again, it may have upon its Shell marks and traces of those different Periods, as the concentrick Circles about the Bodies of Trees denote the different Growths of each Year interrupted at certain Seasons. We shall omit a larger Detail, as well as all the particular Mechanism of the Formation of Shells. It is enough to discover in general, and to see how *some Animals are themselves the Architects of their own Houses, and that the Regularity of those Houses is owing to their concurrent Growth with the Architects themselves, of whom they represent all the different Ages and Conditions.*

We cannot but observe here that whilst Monsieur *Reaumur* studied this Matter, Monsieur *de Verney* likewise applied himself to the same, as making part of the entire History of Snails, which he has undertaken. In the History of 1708, we have taken notice of his Discoveries about their Generation; he proceeds in accounting for every thing concerning this Creature even from its Egg. We shall see in time his Opinion about the Formation of their Shells.

Upon CACHOU.

AS the Naturalists don't well know what to make of those little black Grains, the Substance of which comes from the *Indies*, and what we call *Cachou*, it is the Business of the Chymists to find it out. Monsieur *Boulduc* is perswaded by all the Analyses that he could make of it, that it is a Vegetable Juice. The Extract that is drawn from it by the Spirit of Wine, is both in a greater Quantity, and of a stronger Quality than that which is drawn by Water, a Sign that it is the Sulphur or Resinous Parts that are Predominant in this Compound Body.

Upon the Analysis of HOG-LICE.

THE *Hog-Lice* are an Insect so well known that it would be needless to give a Description of them; only it is good to observe, that Mons. *Lemery* has certainly found out, contrary to the Opinion of some Authors, that they are Viviparous, or that they bring forth alive; he believes there are two Kinds of them, the Domestick, that are found in Cellars, in the Crevaces of Walls, in short, in all moist and salt-petrous Places; and the Wild, that live in Corn-Fields and Woods, and in the Clefts of old Trees.

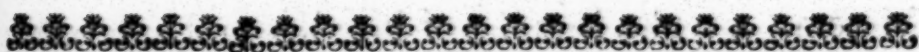


This latter Sort are the smallest, and are least made use of in Physick. The Domestick are preferable, because they seem to be more impregnated with Salt-petre, upon which they feed, and which gives them all their good Quality; for it is that Salt that is proper for opening and dissolving, as in Pains of the *Kidney*, *Jaundice*, *Kings-Evil*, and *Squintie*, &c.

Monf. *Lemery* has drawn from the Domestick *Hog-Lice* by Distillation, a volatile Salt very like that of *Vipers*, and which may be used against the same Distempers and in the same Dose. The Spirit of *Hog-Lice* has the same Vertue, since it is nothing but this volatile Salt that swims in a Phlegm. There comes from *Hog-Lice* as from *Vipers*, and more generally, as from all other Animals, a black and foetid Oil, impregnated likewise with a volatile Salt: This having been mixed with twice as much Spirit of Nitre dephlegmated, there arose a great Effervescence, and Monf. *Lemery* even thinks that he perceived a little Fire in it, but involved, and as it were absorbed by the thickness and blackness of the Oil. This Experiment might resemble the Inflammation produced by the mixture of Spirit of Nitre with the essential Oils of certain Plants; of which mention has been made in the History of 1701, and it would depend on the same Principle; that is to say, the extream Greediness wherewith Sulphurs, thoroughly divested of their Acids, do imbibe it. There might only have been one difference which Monf. *Lemery* has observed; it is that he does not suspect any Alkali in the Essential Oils of Plants, whereas one may believe that there is some in the Oils of Animals, which

which have been drawn by the Retort over a great Fire; for it is very probable that it is the Fire which makes these Alkali's, and so there is nothing but the Experiment of the Oils of Plants that proves that these Alkali's are not the only Matters capable of producing an Effervescence with Acids.

The Coal that remains from the *Hog-Lice* distilled in the Retort having been calcined, Monsieur Lemery found Iron in the Ashes thereof. He has likewise found it in the Ashes of other Animals, but not always. He could draw none from Harts-horn, Ivory, Crabs-Eyes, or Oister-Shells; whereas hitherto it has always been found in the Ashes of Vegetables. Perhaps by repeating the Experiments upon some Matters in which Iron is found, and upon others where it is not, one may in time discover the reason of the Difference.



### Upon Vegetable and Mineral ACIDS.

**W**E have seen that the Sulphur which enters into the Composition of Metals, at least of imperfect ones, is exactly the same with that in Plants, but upon the Experiments made and reported by Monsr. *Homborg*, one would think that the Mineral and Vegetable Acid were very different.

If you pour upon the Spirit of Urine, which is a volatile Alkali, about the like quantity of distilled Vinegar, which is a vegetable Acid, it will not produce either an Ebullition or Effervescence,  
and

and this Tranquility of the two Liquors mixed together will continue till either the Quantity of the Spirit of Urine be very much diminished, or that of the distilled Vinegar very much augmented; but if upon the aforesaid Spirit of Urine, let the Quantity be what it will, you pour a Mineral Acid, such as the Spirit of Salt or Nitre, if there be but a Drop of it, immediately it causes an Ebullition more or less violent, as there is more or less of the Acid, with respect to the Quantity of the Alkali. *Monf. Homberg* relates another Experiment of the like Nature, and which proves the same thing.

Nevertheless, he does not pretend that the Vegetable and Mineral Acids are different. From whence do Plants draw their Acids but from the Earth, and are they not Mineral there? But he supposes that these Acids, both in their own Nature, and when they enter into the Composition of some Mineral, are like Bundles of Needles laid upon one another; whereas, after they have been suck'd by the Roots of Plants, and circulated thro' their narrow Vessels, the Needles are separated, and thereby lose that Strength which they had acquired by their Union. This Notion alone is sufficient to account for the little System of *Monf. Homberg* upon this matter.

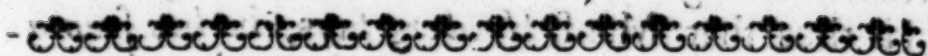
How strong soever the Mineral Acids may be when they lie in Bundles, they nevertheless meet with a great deal of Trouble, when they have to do (not with distilled volatile Alkali's, such as the Spirit of Urine, which are in some manner naked, and entirely exposed to their Action) but with other volatile Alkali's not distilled, that are yet involved



ved and entangled with Oils or other foreign Parts. 'Tis thus that *Monf. Homberg* says, *he has seen a Mixture of Spirit of Nitre and Cantbarides, or Spanish-Flies, cause a little and slow Ebullition for above two Years together.* The occasion of so remarkable a Fact, as it is mention'd in his Dissertation, deserves a particular Attention; it was about a Medicine for the Gravel and the Stone.

*Monf. Homberg* in following the present Theory, has found out a Remedy for a Disease of much less Importance and Consequence to any but the Ladies; it is against the *Tann* and *Freckles* in the Face; but those Remedies, which are the Results of Reasoning, ought to be the more valuable, were it only for their scarceness. He found by Experience that the Gall of an Ox was a Soap like an artificial Soap, that is to say, a Body compounded of an Oil and an Alkali. On the other side, he was of opinion, that the Freckles are an oily and saline part of Sweat, intercepted in the Pores of the Skin; whereupon he conceives that Ox's Gall divested of its oily Parts, and reduced to the Alkaline only, would become a Dissolvent for the Freckles.





### Upon a Singular V E G E T A T I O N.

**W**E shall repeat nothing here of the Fact related by *Monf. Marchant* in his Dissertation ; but, as he has recourse, in the Explanation of it, to a particular Supposition, which belongs to the general System of the Multiplication of Plants, we will treat of it with some Extent, and endeavour to enlighten it as well as we can.

The Eggs of Animals and the Seeds of Plants are the same thing : An Animal and a Plant contained in little, the one in its Egg, and the other in its Seed, come to be unfolded, and then the Animal is said to be Born ; hitherto all is equal on the one side and on the other ; but Plants have ways of being born or produced, which are not in common with Animals : There are several that come by sticking in the Ground ; a Branch of a Fig-tree for instance, stuck into the Ground puts forth Roots, and becomes an entire Plant.

One easily conceives that a Body, let it be never so small, may be organized and grow afterwards, preserving the Disposition of its Parts ; but that a Part should in growing become the Whole, is what cannot be easily comprehended ; for whence can it fetch the other organical Parts that are different from it ? Accordingly, here the Branch of a Fig-tree get Roots that only belong to the entire Tree, and which it could never have contained in little ? No body imagines that from the Leg of an Animal,

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mal, one could ever form its Heart, its Lungs, or in short, a whole Creature.

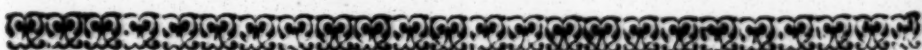
Since one cannot conceive that an organized Part is formed anew, and since the Naturalists are obliged to suppose the Pre-existence thereof in little, we must necessarily grant that there are in the Branch of a Fig-tree little Roots that would never have been unfolded, if such a Branch had not been divided from the Tree, and stuck into the Ground. This Supposition ought to be so much the more easily admitted, that to make an entire Tree of a Branch there is nothing to be added to all that appeared naturally in it but concealed Roots; and that those Roots which would not have shewed themselves if the Branch had not been separated, or if it had remained wholly in the Air, may have been determined to appear by the Earth's touching that part of it which was put into the Ground. The Roots are infinitely less different from the Body of the Tree, than one organical Part of an Animal is from the rest.

All the Ways by which Plants can be multiplied otherwise than by Seeds, are reducible for the Physical System to what we have just now explained; and in *Monf. Marchant's* Dissertation you may see several Experiments to prove that the smallest parts of Plants, and which have been separated from them in different Manners will grow and produce an entire Plant. Thus a Plant contains Seeds in all its Parts, or which is the same thing, it is a Heap and a Composition of an infinite Number of the like small Plants, which do not appear but as Parts of that Whole, and which do not shew what it is that might make them all perfect  
Wholes.



Wholes. The odd Principle of the Scholastick Philosophy, how the Soul is in the Body, viz. *That the Whole is in the Whole, and the Whole in every Part*, is therefore exactly true with respect to Plants; and it is pretty remarkable, that *we really find that to be verified in Matter, which before was imagined as a particular and incomprehensible Property of the Mind.*

After this, it is easie to understand in general, the Cause of singular Vegetations or of monstrous Plants. It is evident, that the manner in which monstrous Animals are formed, as explained in the History of 1702, would not produce monstrous Plants; but if by any Accident a Part of a Plant produces what it ought not to do as a Simple Part, and becomes a kind of a Whole to a Part that is monstrous: The mechanical Structure of Plants being much more simple, and consequently less susceptible of accidental Oddnesses, Monsters in Botany are likewise fewer, and less surprizing.



### *Upon the Circulation of the SAPP in PLANTS.*

**I**N the Year 1667, at the very Birth of the Academy, the late Monsieur Perrault, a Man full of Projects, and mostly of bold ones, and a Philosopher of a brave and original Spirit, advanced the following Proposition, which was then very surprizing; *That the Sapp Circulates in Plants as the Blood does in Animals.* It was not known that a Physician of Hamburg had published the same two Years before.

A Year and half afterwards Monsieur *Mariotte* having been admitted into the Society asserted the same Hypothesis as a new one, but found that Monsieur *Perrault* had prevented him; and tho' he was pleased to find that this Conformity of their Sentiments was a sort of Proof of his System, he was not perhaps less sorry that another had ravished the Honour of it from him. The Illustrious *Monf. Malpighi*, in whom the Genius of Invention has shined so bright, was likewise of the same Opinion. Messieurs *Perrault* and *Marriotte* have both of 'em published theirs, with all the Proofs, in their *Essays upon Physicks*; however, the Academy, which values it self upon a prudent Slowness, has never been fully satisfied in this Matter, and Messieurs *du Clos* and *Dodart* amongst others, have always enter'd their Protestation against this Opinion.

Monsieur *Dodart* allowed indeed, that there was a Juice which ascended from the Roots of Plants quite up to the Extremities of the Branches, and even of the Leaves; and also a Juice, which from those Extremities descended to the Roots. One of his chief Reasons was, that if you transplant at the same time two Trees of the same Kind, after having cut their Branches and Roots, if afterwards the two Trees having taken new Root, you cut off from one of them some of the new Branches of every Year, you will see that it will thrive much less by the Trunk and by the Roots than the other; which proves that those Parts receive a Nourishment by the Branches. He fancied that that Nourishment was more aërial, because it was formed of the Moisture of the Air, of the Dews, &c. whereas that which came by the Roots was more Terrestrial. But finally he pretended

tended that the Ascending and Descending Juices were not the same, or that the Juice that ascended did not re-descend, and reciprocally; and so by Consequence that there was no such thing as the Circulation of the Sapp.

Monſieur *Magnol* has attacked the System of Circulation yet more directly, by answering in Detail all the Arguments and all the Experiments too that are found in Monſieur *Perrault's* Treatise upon this Subject.

His Arguments are drawn for the most part from the Analogy of Plants and Animals, which render the Necessity of Circulation equal in both. But this Analogy, as specious and entertaining as it is, if one would attend to it a little, does not strictly conclude much, and it is not difficult for Monſieur *Magnol* to answer all that it suggests. We will not stop at this Article, because they are simple Probabilities, which it is as easie to refute as maintain.

Experiments are more decisive, at least they ought to be so; but oftentimes it is not more easy to produce one that shall be very concluding and uncontestable, than a Physical Demonstration consisting in a simple Argument of 25 Experiments, that Monſ. *Perrault* had collected to support his System. Monſieur *Magnol* denies the greatest Part, and pretends that the rest proved nothing. We will stop at nothing, but what is of Importance in the whole. Monſieur *Perrault* had advanced, that when young Sprigs were Frozen or Browzed by the Cattle, the rest of the Tree would languish or die, because the evil Qualities contracted by those Accidents, did communicate themselves to the whole Body



Body of the Plant by the means of Circulation; that for the same reason *Misseltoe*, and *Moss* kill the Trees; that when one strips them entirely of their Leaves, their Fruit does not thrive so well, being deprived of that Juice which was to have been communicated to them by the Leaves; that if one makes a Ligature at the Stalk or Body of a Plant that is accustomed to yield a great deal of Juice, such as the great *Titbimale* or *Milk-thistle*, the Stalk will swell above the Ligature, which proves both that there is a descending Juice, and that this Juice is more Coarse and Thick than the ascending, since the latter caused no Swelling; that if you cut the Stalk of a Poppy four Fingers below its Head, one sees, when it begins to die, a very white Juice come out of it ascending, and a yellowish descending. Monsieur *Magnol* peremptorily denies all these Facts. It is not to be doubted that Monsieur *Perrault* saw them, but probably did not repeat them often enough, nor sift them every way as narrowly as he should have done: *A Man should stand upon his Guard, even against himself when he sees things that he is desirous of seeing.*

There are several other Facts that *Monf. Magnol* admits, but disputes the Consequences which *Monf. Perrault* draws from them; for instance, there are Trees, such as the Elder, the Vine, &c. the Branches of which lying along the Ground take Root in it; after which, if they are cut off and separated from the Tree, they become themselves new Trees, the Position of which is contrary to what it would naturally have been. It is true, that then the Sapp which ought to nourish the Tree, has a Motion contrary to that it would have

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had in the same Channels; but that only proves that those Channels permit the Sapp to run indifferently the one way or the other, according to the Position of those Channels with respect to the Earth. That Indifference will be yet more sensible if one could make, and that with ease too, as some Authors have writ, the Roots of a Young Lime-tree become its Branches, and reciprocally its Branches Roots.

To the Experiments whereby Monsieur *Perrault* proves that there are different Juices in Plants, *Monf. Magnol* answers likewise, by allowing that there are so, and that they ought to be such, since there are Parts of a different Nature to be nourished; but he denies that those Juices ascend, and afterwards descend to rise again.

Monsieur *Perrault* conceived that those Juices which returned from the Extremities of the Branches to the Root, were destined for its Nourishment, and those that came from the Root, for the Nourishment of the rest of the Tree. *Monf. Magnol* opposes this Opinion by several Experiments: 1. A Lively Plant cut off even at the Root, will put forth again with Vigour, tho' according to *Monf. Perrault's* Hypothesis, the Root deprived of all Nourishment should have died. 2. An Olive-tree likewise being cut down to the Ground put forth a great many Sprigs that became Trees. 3. A Bulbe planted in the Ground thrusts out several Roots before the Leaves. It cannot therefore be the Juice descending from the Leaves that supplies the Roots with Nourishment.

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The Circulation by which the Juices are more attenuated, more refined, and in some Sense more tormented than by a simple direct Motion, induced *Monf. Perrault* to affirm that a Juice much prepared is necessary to Plants; but *Monfieur Magnol* does not assent to the necessity of this great Preparation. He put the Stalk of a Tube-rose, that was blown during a whole Night into the Juice of *Solanum Racemosum*, mixed with a little Water. This Juice is of the colour of *Lack*, and the Tube-rose became a fine Rosey colour. It did not appear that the Juices which produced such a change in the Colour of the Flower, and which by Consequence did very intimately nourish the Plant, could be much alter'd or much operated. We likewise know that there needs nothing but a little Water to revive a Plant taken out of the Earth even after it has begun to wither, and sometimes to make it Vegetate likewise.

Nevertheless it must be owned after all, that *Monfieur Perrault* has some Proofs which are not easily destroyed. He had taken out of the Earth several Plants of the same kind, and entire with their Roots, one of which had its Trunk divided into two Branches; he plunged into Water one of those Branches only, and so let it remain several Days; by which means it did not only continue alive, but also put out new Leaves on that side which had not been in the Water, whilst the other Plants were entirely wither'd. Other Authors have made a like Experiment. When one can meet by chance with a Tree supported by two great Roots, one of which is uncover'd about a Foot and a half, and cuts it off at four Fingers breadth above

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the Earth, so that the upper part, which is above a Foot in length, must wither if it only attracts its Nourishment from the Earth, with which it has no longer any Communication, yet far from withering, the Year following it will put forth Branches and Leaves. These Facts which are not disputed, prove the motion of the Sapp from the top to the bottom, but can that be called Circulation? Here follows another Fact that does prove it, or at least that there is a Juice ascending, and another different Juice which descends by other Channels.

They took a piece of a small Branch of an Elm without Knots, about the length of three Inches, and at each end they fasten'd a little Tunnel made with Wax; then they cut the Branch in two, and poured Water into those Tunnels. The Water did not pass, but into that piece of the Wood which had the Tunnel at the end that was nearest the Branches. After this, instead of Water they put Spirit of Wine into the Tunnels, which readily insinuated it self into that piece where the Water could not pass, but was a great while a getting thorough that Piece which had admitted the Water; the same thing happen'd to other sorts of Wood. Upon considering the Position of these two pieces of the Branch, when they made part of the Tree, Monsieur *Perrault* concludes, that the Tubes or Channels, which suffer'd the Spirit of Wine to pass, were *Ascending*, but those which admitted the Water *Descending*; and that the Liquor which ran thro' the *Ascending* Channels, were more Spirituous and Subtile, but those in the *Descending* more Coarse and Watry. Hitherto the whole is pretty well proved, at least as to

to some kind of Trees, and afterwards it is a Conjecture, that may pass for probable, that these two different Liquors are but the same, which being filled with Spirituous Parts, when they Ascend from the Root, leave by the way the greatest quantity for the Nourishment of the Trunks and Branches; and after that brings nothing more from the Extremities of the Branches, but its most gross Parts, mixed with the Moistures of the Air, or with Rain-Water. Monsieur *Perrault* supposes moreover, that this returning Sapp is fittest for the Nourishment of the Branches.

Upon this Matter, as well as upon many other, one must wait for farther Light from time. *It is difficult in Physicks to get as far as a System, it is even sometimes as hard entirely to overturn one.*



*Upon the Progressive Motion of several Kinds of*  
**SHELL-FISHES:**

**W**H O' Animals in general have an indispensable need of Progressive Motion, whether it be for procuring their Food, or other Occasions; there are nevertheless a great Number, that by their Figure alone seem incapable thereof; such are several Sorts of Shell-Fishes; and it is for this Reason that Monsieur *Reaumur* has observed them very carefully, lest they should, as one may say, rob us of their manner of Walking; for oftentimes such a matter of Fact, tho' altogether External, is as hard to be discover'd, as the Internal Structure of the Parts of Bodies.

The late Monsieur *Poupart* has already observed that the River-*Muscles* lying upon the flat Sides of their Shells, did protrude, as often as they had a mind, a part, which from its use one may call a Leg or an Arm, that it served to dig the Sand under them, and consequently to turn them gently on one side; so that at last they would be upon the Edge of their Shells, after which they put forward this same Leg as far as they could, and then leaned upon its Extremity to draw their Shells to them, and so slide along in a kind of a Track or Channel, which they formed in the Sand, and which supported the Shell on both Sides: When one looks upon a Muscle, one would not think it capable of this Expedient and Resource of Mechanism.

Monsieur *Reaumur* has observed in the Sea-Muscles, what one may also call their Leg or Arm, and which, being in its natural State, is but the length of two Lines, and yet can be extended or produced by them as far as two Inches out of their Shell, whereby the Animal having laid hold of some fixed place, it contracts its Arm again, and consequently advances by drawing it self along.

By such a kind of Management, the Detail of which we leave to him that discovered it, the *Lavignon*, another Shell-Fish, marches upon the Mudd or sinks it self into it; But Monsieur *Reaumur* observes, that tho' he sinks himself down, it is not deeper than the length of two Horns, or Tubes, that he thrusts out of his Shell, will permit him; and that it is with those Tubes that he takes in and throws out Water, of which he probably stands in need for Respiration. These Horns must always have Communication with the Water that is  
above



above him, from whence it happens, that at such times as he does not use them, there is in the Mudd, under which he lies, one or two little Holes of the Diameter of those Horns, by which he is discover'd.

The length of their Horns in other Shell-Fishes that have 'em, do likewise determine how deep they hide themselves in the Mudd.

The *Goats-Eye*, which is a Shell of one piece only, and is always fasten'd to a Stone, to which the lower Circumference of the Shell can exactly apply it self, does not seem to have any other Motion than to be able to raise its Shell the height of a Line, so that its Body has a Circumference of that extent naked and uncover'd, but as soon as it is touched, the Shell falls down and covers it again. However *Monf. Reaumur* has discover'd in this Animal a Progressive Motion upon the Stone to which it glews it self.

The *Ortie of the Sea*, which has the Figure of a broken or blunted *Cone*, is likewise always fasten'd upon a Stone by the largest Basis of its *Cone*. Some Circular Muscles are the Plane of the two Basis, and some streight Muscles pass from one Basis to the other. The whole Mechanism of their Progressive Motion consists in general herein ; that half the Muscles, as well circular as streight, which are on the side towards which the Animal would go, are swelled and extended, and consequently takes up a small part of a new place, whilst the other half is either drawn by that which advances or pushes it self on after the same manner. This Motion is neither quicker nor more visible than that of the Hand of a Clock.

There is another *Sea-Ortie* which fastens it self to nothing, and is the oddest of all Fishes by its Figure, and the most singular by its little Consistence, because it will melt in your Hands. It would hardly deserve to be ranged under the Class of Animals, if one did not discover in it the Motion of *Systole* and *Diastole*, the only Tokens it gives of being alive.

Lastly, The *Sea-Star*, tho' it has 304 Legs at each of the five Rays of which it is composed, and from whence it derives its Name of *Star*, does not go the faster for all that. His 1520 Legs don't give him any advantage above the *Muscle* that has but one. *What a prodigious Variety of the Works of Nature ! Not only the great Swift-ness of Motion, but even the extreamest Slowness are performed in different Manners.*



### *Upon the MUSCLES of the Lakes or Ponds.*

**W**E know well enough, at least to a certain Degree, the Animals that are most exposed to our Eyes, and with which we have, as I may say, the chiefest Dealings : But there are an infinite Number of others which the little Occasion we have of 'em, the Difficulty of observing them, and a certain Contempt arising either from their Smallness, or Figure, make us neglect or absolutely deprive us of the Knowledge of them : Such are chiefly the *Insects* and *small Fishes*.

Who would believe that there is an Animal that is nourished and respire only by the *Anus*, that has  
neither

*Upon the Muscles of the Lakes or Ponds.* 403

neither Veins nor Arteries, and consequently no Circulation of Blood? To say nothing of its being a Hermaphrodite, which is now so common, that it is no longer a Wonder; but this Creature however is different from all the other Hermaphrodites we yet know; for as much as it multiplies it self independently of another Animal of the same Kind, and is it self both Father and Mother of that which is produced by it. This is an Idea of an Animal entirely New: It is the *Muscle* of the *Lake* or *Pond* of which Monsieur *Mery* has discover'd the Structure in spite of its Figure, shapeless almost, and discouraging thro' its excessive Singularity.

That which one may call the Head in this Creature, tho' there be neither Eyes, nor Ears, nor Tongue in it, but only a little hole to which he gives the Name of Mouth, is an immoveable Part and fasten'd to one of its Shells, so that it cannot go and seek for its Food, but the Food must come to it, and all the Food it uses is nothing but Water, which when the Shell opens enters in by the *Anus* of the *Muscle* that likewise opens it self at the same time; from thence it passes into certain Receptacles contained between the Internal Superficies of the Shell, and the External Superficies of the Animal, and at last is discharged into the Mouth of this Animal when by a certain Motion he draws it in.

At the bottom of the Mouth two Vessels present themselves to receive the Water, one of which disperses several Branches into the Body of the *Muscle*, among which one terminates in the Heart; the other Vessel is a kind of Intestine, which passes at first by the Brain; then makes several Circumvolutions in the Liver, and passing on crosses the Heart in a streight Line, and at last ends in the *Anus*.



ON This Brain and this Liver are only supposed to be such Parts; the Heart is a little more really so, having in it a Ventricle and two little Ears, and the Motions of *Systole* and *Diastole* alternately in the Ventricle, and in the little Ears; but there are neither Veins nor Arteries; the Water that is brought to him by the Channel before-mentioned, passes from the Ventricle into the little Ears, and returns from the same into the Ventricle, making a slight Representation of circulating without any apparent Effect, for when it is once come to the Heart, it has no way of getting out again. What then becomes of the quantity that must be there amassed? Probably there is no Collection at all of it, because the Animal does not continually derive Water by the Mouth to his Heart; and when he has brought a certain quantity into it, the Contractions of the Heart evaporate it through his Pores, and force it into the neighbouring Parts which are refreshed and nourished by it.

The Channel which *Monf. Mery* calls the Intestine, and which, as well as the other, immediately receives the Water from the Mouth, does not seem proper to convey Nourishment to the Parts, because it has no Branches to distribute it; nevertheless it contains, towards its beginning and towards its end, pretty different Matters, the first of which may perhaps be the Water digested, that is to say, the nutritious Juices extracted from it; and the other may be the Excrements.

The *Muscle* can't respire but when it raises it self above the Surface of the Water, and it raises it self as other Fishes do by the Dilatation it makes of the Air contained in it self, whilst it dilates the  
Cavity

Cavity in which that Air was shut up. Then it is still by its *Anus* that it receives the External Air, and conducts it into its Lungs; but it does not seem to be very necessary to it, because this Fish is almost always plunged to the bottom of the Water.

These *Muscles* have both *Ovaria* and *Seminal Vessels*. These two Kinds of Organs are equally composed of Tubes that lie parallel with each other, all closed at one end, and open at the opposite. One can't distinguish these Parts by their Structure, which is all alike to the Sight, but by the difference of what they contain, and that the more easily, because the *Ovaria* are always full of Eggs in Winter and empty in Summer, and that in the Vesicles there is at all times an equal quantity of their Milk, of which there being but very little, it should seem that it is always discharged. All the Channels or Tubes are discharged in the *Anus*; and *Monf. Mery* is of opinion, that when the Eggs fall down there, at the Season of their coming out, they cannot fail to meet with Milk or Seed, which may render them fertile. This Animal therefore does not want the Assistance of another for Generation.

*Monf. Mery* does not agree with the late *Monsieur Poupart*, about the Progressive Motion of these Fishes. He pretends that their whole Belly, which when they please, they can protrude the length of two Inches out of their Shells, in the figure of the Keel of a Ship, creeps along the Mudd as the Belly of a Serpent does upon the Land: He describes the *Muscles* which by their alternate Contractions perform the whole Work of this Mechanism.

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He does not believe neither, that the Shell of this Fish is formed after the same manner as that of a Snail, according to Mons. *Reaumur's* Description of it. The first turns of the Snail's Shell are not bigger in a larger and older Snail, which proves that the Shell is not a Member of the *Animal*, nor made by a successive Addition of foreign Parts, but certain *Fascia* or *Bands* which one perceives upon the Shell of a Muscle, are larger in proportion to the Growth of the Fish; besides, this Animal has eight Muscles fasten'd to the internal Surface of its Shell; wherefore if the Shell does not grow in the same manner as the Fish, those Muscles that were first fasten'd to certain parts of the growing Fish would continually change their Place, even till the Fish had done growing, but how is that possible? The Difficulty is considerable, but perhaps it may be no more than a Difficulty for all that.



*Upon the TREES killed by the FROST in 1709.*

THE violent Winter of the Year 1709, the Remembrance of which will last a long time, kill'd a prodigious number of Trees throughout all *France*; but it has been observed that this Mortality did not extend it self indifferently upon all: Those which one would have believed ought to have been most exempt by their Strength, suffer'd most of all. The hardiest Trees and those which keep their Leaves all the Winter, as the Lawrel, Cypress, and Green Oak; and



and among others that are more tender, as the Olive, Chesnut and Walnut, those that were oldest and strongest of 'em died in the greatest Quantity.

The Cause of this appearing oddness, was enquired into at the Academy, *Monf. Cassini*, the Son, alledged a very plain one with respect to the old Trees. He said, he had observed that the great Cold had loosen'd the Bark from the Wood, however it came to pass, in effect it is very Natural that the Bark should stick fastest to the Wood in young Trees that are much more full of Juice, and of a Juice that is more oily too. Now as according to the common Opinion of the Naturalists, it is chiefly by the Bark that the Trees receive their Nourishment, it must needs have happen'd that those, in which the Bark does most easily lose the Communication it had with the Wood, should die sooner than others.

*Monf. Chomel* fancied another Reason, and that more General. There came first a very strong Frost, which was succeeded by a Thaw; then a second Frost as strong as the former, and very sudden. The Moisture of the Thaw wherewith the Trees were filled, was therefore congealed again, that is to say, it did extend and dilate it self with great Violence and Quickness, and so exercised upon the Fibres, and all the organical Parts of the Trees, an Effort which was so much the greater as it met with more Resistance. Now it is certain it met with most from the strongest Trees, in which therefore it tore and destroyed their organical Parts, Fibres, Vessels, &c. and so render'd them useless for Vegetation.

○ If one adds to this, according to *Monfieur de la Hire's* System, followed by *Monf. Chomel*, that Cold consists in certain saline Particles very penetrating, the Action would have still been stronger, and the Effect greater.

○ That the hardest or oldest Trees should make such a Resistance as provoked the Enemy the more, there is no room to doubt. Their Parts are necessarily closer and more Compact; for which reason it is that they put forth their Leaves later than others, all the rest being equal. The Unfoldings in which all Vegetations consist, must be performed more slowly in those tough Trees, than in such whose Parts are softer, more flexible, and more impregnated with Juice.

○ In relation to old Trees, *Monf. Homberg* did likewise give a particular Reason of their greater Resistance. Their Fibres which are at their full Growth, and consequently are every way extended as much as they can be, are not able to undergo a new Extension, but powerfully resist all Rarefaction, whether it be of the watry Juices they naturally contain, or of any foreign Moisture. On the contrary it is visible that the Fibres of young Trees are capable of being extended every way.

Several Trees that seemed to have escaped the Cruelty of this Winter, because they put out new Branches and Leaves at the Return of the Sapp in Spring, could not reap the Benefit of that in Autumn, and so perished entirely. When they were cut they were found more black and burnt at the Heart than towards the *Aubier*, or softer part of the Wood next the inner Bark. The Heart, which is the hardest, had been more damaged than  
the

upon Corn called *Ergot*, or the *Spur*. 409  
the *Aubier*, and it was already Dead, whilst the  
*Aubier* still preserved a small remnant of Life.



Upon the *Horned* or *Crooked* CORN called  
ERGOT or the SPUR.

THE Academy lately received some Ac-  
counts of a Gangreen or Mortification  
that was become pretty common in cer-  
tain Countries, especially in the *Orleanois*  
and in the *Blefois*. Monsieur Noel, Surgeon of  
the Hospital at *Orleans*, is he that has given the  
most particular Relations concerning it; he ac-  
quainted Mons. Mery there were come to his Hos-  
pital above 50 Persons, both Men and Children,  
that had been afflicted with a Dry, Black and Livid  
Mortification, which began always at the Toes,  
continued more or less, and sometimes rose up to  
the Thigh; that he had but one Patient that had  
had the Distemper in his Hand. The Mortifica-  
tion left some without any Application, others  
were cured by the help of Scarifications and Topics;  
Four or Five died after the Mortified Part was cut  
off, because the Distemper continued to rise up to  
the Trunk or Body. That which was most sur-  
prising is, that the Women were not troubled with  
it, or at most a few little Girls.

The Academy was likewise informed, that the  
same Accident had befallen a Peasant near *Blois*,  
but after a much severer manner. He lost at once  
all the Toes of one Foot by the Mortification,  
after that, those of the other, after that, the rest



of his two Feet ; and finally the Flesh of both Legs and of his Thighs fell off successively, and left nothing but the Bones. At the time when this Account was writ, the Cavities of the Bones of his Hips began to be filled with good and new Flesh.

It was thought, and with pretty much probability, that this strange Distemper, which only attacks Poor People, and in the Times of Dearth and Scarcity proceeds from bad Food, and particularly from a certain Corn, Black and Horned, which they call *Ergot*, because it really resembles the Figure of a *Cocks Spur*. *Monf. Fagon*, the King's first Physician, and Honorary Academist explains the matter thus.

There are certain Mists or Foggs that spoil the Wheat, but from which the most part of the *Ears* of Rye are secured by their Beards. In those which this malignant Moisture can reach and penetrate, it Rotts the Skin that covers the Grain, Blackening it, and Changes the Substance of the Grain it self. The Sapp that ascends into it, being no longer confined by the Skin within the ordinary Bounds, comes in too great abundance ; and by its Irregularity Forms a kind of Monster, which is moreover Noxious and Unwholsome, because it consists of a Mixture of this Superfluous Sapp with a vicious Moisture.

It is only in the Rye that the *Ergot* is found, and whether it be that the same Causes which produce the Barrenness of a Year, do likewise produce it in greater Quantities ; or whether it be that in a bad Year the poor People do not separate it from the good Grain, of which they have but a little ; 'tis only in such Seasons, and among those poor People, that the Gangreens we have mentioned, are to be found

found. *Monf. Noel* says, that as the *Rye* of *Sologne* had near a fourth Part of *Ergot* in it in the Year 1709, as soon as the Country People did eat of the Bread that was made from it, they found themselves almost intoxicated, after which the Mortification often followed; but that in the Country of *Beauſſe* where there was little *Ergot*, these Accidents were not known. It may be worth while to read upon this Occasion a very Remarkable Letter of the late *Monf. Dodart*, inserted in the *Journal de Sçavans* 16 March 1676.

The Academy, zealous of promoting the Publick Good as far as it lay in their Power, writ to the Count de *Ponchartrain* what they had learned of the Evil Effects of this Sort of Corn, to the end that he might be pleased to take such order in it as he should think most proper. The King approved their Zeal, and ordered that Minister to write to the Intendant of *Orleans*, to acquaint the Peasants of his District, with the very great danger of the use of *Ergot*, and to oblige them to *cleanse* their Corn thoroughly before they sent it to the Mill; and for that purpose he communicated to him *Monf. Fagon's* Memorial upon that Subject.

About the same time, and in order to procure a farther Information of this matter, *Monf. de la Hire* the Son, writ to one of his Friends, a good Physician in the Country, desiring him to examine the Farmers what they attributed the Production of this Horned Corn to, to perswade them to give some of it their Poultry, and to observe what would happen thereupon; and lastly, to Sow some of it, and see whether it would Spring up; all which was done

accordingly, and he received the following Account about it.

1. *This bad kind of Grain does most abound in cold and moist Lands, and in rainy Years: A particular sort of Rye, that is sown in March, is more subject to it than that which is sown in Autumn.*

2. *The Poultry would not touch it as soon as they discover'd it, and whatever Art was used by mixing it in their Food, they chose rather to Fast two or three Days than to eat of it; and yet it did not appear to hurt them, when they eat of it unawares, nor did they cease to lay their Eggs as usual.*

3. *It will not spring up at all, which is very natural, and at the same time very happy.*



### *Upon the PLANTS in the SEA.*

**T**HE Study of Terrestrial Botany, tho' so Painful and Fatiguing as it has been represented in the Life of Monsieur *Tournefort*, is not however so tedious as that of the Marine Botany. One must go to Sea along with the Fishermen; for otherwise, what they don't look for, tho' it would sometimes make a Botanist overjoyed, they throw away immediately, whatever Order you give 'em to the contrary. And what is yet more irksome, is, that you must expect nothing but from Chance, one sees none of those Plants, the Net takes 'em where it can, and how it can.

Not



Notwithstanding these Difficulties, Count *Marsigli* has begun a very considerable *Marine Botany*, all composed of Plants of his own getting. He divides them into three Classes; the Soft, those that are almost of Wood, and the Stony: This Division is not very different from that which the late Monsieur *Tournefort* communicated to the Academy in the Year 1700, tho' Mons. *Marsigli* declares, that he don't pretend to follow a rigorous Method of Botany.

The soft Plants are the *Algae*, the *Fucus*, the *Sponge*, and the *Sea-Moss*, &c.

The Plants that is almost Wood, is the *Lithophyton*, so called by the Ancients, because they took it for a Stone Plant. The whole Composition of this Plant consists of two Parts, the Bark and the Substance; the Bark when it is just taken out of the Sea is soft, but as it dries, becomes hard like Chalk, and will crumble between ones Fingers, which probably deceived the Ancients: Its Substance is of more the Nature of Horn than Wood; if one Burns it, it rises in Blisters just like Horn, and has the same stinking Smell. The Branches of the *Lithophyton* are as pliable as Whalebone, and resist the Knife in the same manner.

The Stone Plants, and which only deserve the Name of *Lithophyton*, tho' they have it not, are the *Corrals* and *Madrepores*. Mons. *Marsigli* does not mention some other kinds, such as the *Stone-Musherooms*, because they are not found in the Sea about *Provence*. *Corral* is well enough known by its external Figure; the *Madrepore* differs from it in that it has no Bark, is usually White, and has pretty visible Holes in it.

Monfieur *Marsigli* having no Books by him when he made his Observations, could not Search any Authors concerning the Descriptions of those Plants which he had Fished out of the Sea, nor what Names they had given to them, nor under what Classes they had reduced them, tho' these things are very important in Botany. He was therefore obliged either to call them as the Fishermen did, or to give them Names sometimes at a venture, or finally to leave them without Names, and refer to the Botanists of the Academy the Care of enquiring into their true Names, and of discovering their general Characters.

Monfieur *Marchant*, who took this trouble upon him, could not succeed in it as he desired; for besides the difficulty of reducing to certain Kinds those Plants in which the principal Parts that characterize others are not found, such as the Roots, Flowers and Fruits, he had nothing but Monfieur *Marsigli's* Description of them, and not the Plants themselves; and if he had had them, that would scarce have been sufficient, because they often change very much, when they have been a while out of the Sea. However, he did all that was possible to be done; he ranged several of Monfieur *Marsigli's* Plants, under their proper Kinds, and found out the Names that Authors had already given them. We shall not however amuse ourselves with these Discoveries, but only Extract from Monf. *Marsigli's* Account that which is most Philosophical therein.

The *Algae's* are only the Sea Plants that have Roots, and they therefore spring from Muddy Bottoms, like the Terrestrial Plants. All the rest, without Exception, grow upon hard Bodies, as  
upon

Rocks, Shells, pieces of Iron, Conglutinations of Earth, Wood, and even upon other Plants, &c. they are closely fasten'd to them by their Stalk or Foot ; but neither hath this Foot any Fibres proper to draw Nourishment, nor can the most part of the Bodies that bear these Plants be suspected of being capable to furnish it.

Monsieur *Marfigli* believes, that all these Plants which have no Roots are all Root themselves ; that is to say, that they attract their Nourishment by an Infinity of Pores that are found in all Parts of them ; some of 'em being full of very visible Holes. This manner of Vegetating is very convenient for them, because they are surrounded with the Water of the Sea on all Sides, which bring them their Nourishment ; whereas the Terrestrial Plants that receive theirs from the Earth, but have but one part that is embraced by it, stand in need of a particular Disposition and Organs in that Part : And accordingly all the Marine Plants, as far as Mons. *Marfigli* could discover the Contexture of them, both by his naked Eye, and with the help of the Microscopes, are only composed of a heap of little Glands, or very small Vessels, that filtrate the Sea Water, and separate the Juices that are proper for their Nourishment ; which Juices are commonly glutinous and milky.

If one Part of a soft Plant, or of a *Lithophyton*, is in the Sea Water, it continues fresh and alive, whilst the other Part that is out dries away. The contrary happens to Terrestrial Plants, all the Parts of which will remain alive, provided that one alone of 'em stand in the Water ; this proves that the Communication which is between the Parts of the Ter-



restrial Plants is not between those of the Marine Plants, and that the Parts of the latter are nourished independantly on each other; and by a certain *Apposition* of Matter, which derives it self to each of 'em in particular. After this general Idea of the Marine Plants, we will collect some of the most remarkable Particularities observed by Monsieur *Marsigli*.

There is a *Fucus*, the Foot of which is a quarter of an Inch in Diameter whilst the Plants are fresh, but it becomes as slender as a Thread when it has lost the Water it contained.

There is another that creeps along upon the Rock with much Irregularity, so that one cannot distinguish its real Foot.

The *Sea-Orange*, which is a kind of *Fucus*, bears that Name because of its round Figure. It has neither Body nor Branches, and in short is nothing but an Orange, being about 4 Inches and a half in Diameter, but the Substance of it is no more than one Line and a half. All the rest is only a great Concavity, sustained by a vast number of Filaments that cross it, and filled with the Sea-Water that has been filtrated by the little Glands of its Substance.

There is another Plant that is nothing but a Bark, and it commonly grows upon those *Lithophytous* that have lost all, or most part of their own Bark. It never covers any but the naked of 'em, sometimes it cloaths the Stone. When it is alive it is as thick as the back of a Knife; the Substance of it is like that of a Mushroom, and the Colour a bright Red. Its external Surface is all over cover'd with a great Number of Swellings, full of a glutinous Juice.

Juice. About those Swellings one sees many Buttons or little Tubes of an Aurora Colour, which upon a fine red Ground makes a very agreeable Effect. The Internal Surface is quite smooth, and accommodates it self to the Figure of the Body over which it is extended. This Plant is of a much more singular Nature than the Terrestrial Plants, that only live upon others.

Several kinds of Sponges when they come out of the Sea, have, in certain little Holes, a Motion of *Systole* and *Diastole*, which lasts till the Water inclosed in them be quite spent.

Some Plants of the Class of soft ones, when dry, crumble as easily between the Fingers as the Bark of the *Lithophyton*.

There is a *Lithophyton* that has such a great Number of Capillary Branches, that it seems to compose a kind of Tree with Leaves. However, as all those Branches are perfectly of the same Substance with the Trunk, it is true without Exception, that none of the *Lithophytons* have Leaves.

There is a kind of *Lithophyton* without Bark; its Superfices is cover'd with a glutinous Matter, like a Varnish, which most abounds at the Foot of it. This Plant is all full of Thorns, which appear best at the Top of the Branches, where there is least of the Varnish. One sees likewise about them, as they come out of the Water, certain little Globules of a Glutinous Matter, which when the Plant is put into a Vessel full of Sea Water, spread themselves about the Branches, making an agreeable Symmetry.

The *Coral* grows ordinarily in Grotto's, of which the Concave Vault is almost parallel with

the Superfices of the Earth; the Sea is as smooth there as a Pond, the Fishermen assure, and *Monf. Marfigli* believes till now upon his own Observation, that *Coral* does not grow in those Grotto's that are open towards the North, they must be turned towards the South, or at least towards the East or West. It grows best and quickest where the Sea is shallowest. It grows quite contrary to Terrestrial Plants, and even to the soft Sea Plants and *Lithophytons*, for its Root or Foot is fasten'd to the Top of the Grotto, and its Head or Branches are turned downwards.

It is equally hard, and red, in and out of the Water; only its Bark, as it dries, assumes a Colour a little more Livid, and the Extremities of its Branches are softer when they come out of the Sea, than the rest of the Plant, being full of a Juice that is not yet Consolidated; these Extremities as they dry in the Air become Friable.

The Foot by which the *Coral* is fasten'd to a solid Body, assumes exactly the Figure of that Body, embracing in it the form of a Plate or Covering to a certain extent, which plainly proves that the Substance of *Coral* was fluid in its first Formation; and that which proves it yet better is, that this same Substance, tapisses or lines the inside of a Shell, into which it could not enter but as a Liquid.

The Bark extends it self equally throughout, it is less compact and less hard than the Internal Substance which is Stony, and is easily separated from it, when the Plant is new; it is filled and all cross'd with little round Tubes, which have each of 'em at their Top a hole so small, that its scarce perceptible but with a Microscope; they are full of a  
Glutinous



Glutinous Juice, which while the Plant is fresh and young, is of a milky Colour, but being afterwards condensed assumes the Colour of Saffron bordering upon a Red. The Internal Surface of the Bark is all shagreen'd or rugged with an Infinity of little Glands.

The Superfices of the *Coral*, divested of its Bark, is all traced with Channels that run from the Plate or Foot, quite to the Extremities of the Branches. There is in the proper Substance of the Plant a number of these little Cells, full of a Juice exactly like that in the little Tubes of the Bark, but these Cells are not visible, and perhaps do only exist in the External Circumference of the proper Substance; all the inside appears perfectly Solid and Stony. The Cells are likewise larger and more numerous towards the Extremities of the Branches, than towards the Foot.

All this together seems sufficiently to prove that the whole Organical Structure of *Coral*, with respect to Vegetation, consists in its Bark, and in the Superfices of the Coraline Substance, that the Bark filters by its Tubes a Juice that spreads it self between the said Bark and the Substance, filling the little Cells thereof, and running along the Channels, even to the Extremities of the Branches; and that this Juice being petrified as well in the Cells which surround the Coraline Substance, as in those of the Extremities of the Branches, whose Substance is not yet formed, makes the Plant grow both in Bigness and Tallness. We are obliged to content ourselves with this Explanation, tho' very slight and imperfect in comparison of that into which Count *Marfigli* enter'd with Pleasure, upon  
fo

so singular a Vegetation, whereof he has given the first Account.

*Coral* is eaten by the Worms; *Monf. Marfigli* has given us the Figure of a Piece so eaten, and intends to describe it yet better in his Dissertation upon Sea-Animals.

The *Madrepores* grow commonly in the same places as *Coral*.

Most of them change their Colour out of the Sea.

They are commonly more heavy and easie to be crumbled. Some of them are as brittle as Glass, and others yet more, so that one can hardly touch them.

This is what relates to the most curious Particulars of the Marine Plants of the three Classes, but we have not yet touched upon their Multiplication, an essential part, but very obscure in this Botany. To see the Flowers, or Fruits, or Seeds, of a Marine Plant, one must be doubly favour'd by Fortune; one must draw it out of the Sea by a Net that distinguishes nothing, and take it exactly at a time when it is in Blossom or Seed. And tho' we have always the Terrestrial Plants under our Eyes and at our own Command; yet there are still some of them, as the Mushrooms and Troufles, which have concealed from us for a very long time the manner of their Multiplication.

Nevertheless, as the Diligence of an Observer compels Fortune to be favourable at last, Count *Marfigli*, in the Year 1707, made a Discovery which will be for ever famous in the Marine Botany. It is that of the Flowers of Corral, they  
are

are white, having each of 'em a little Foot and eight Leaves, which are altogether of the size and figure of a Glove. They are very numerous throughout the whole Plant. They come out of all the little Tubes of the Bark, and return into them again at the very instant you take the Plant out of the Water; but put the Plant in again, and the Flowers will appear in less than an Hour's Time; and in this manner you may deal with it sometimes for the space of twelve Days, after which the Flowers assume the Shape of a little yellow Globe, and fall off from the Plant to the bottom of the Water, the Description of this Phenomenon has been published more at large in the Supplement of the *Journal des Sçavans* for the Year 1707. It has been long thought that Coral was nothing but a Stone, and what would People have said to have seen such a Stone cover'd all over with Flowers? As for us who know that it is a Plant, we cannot forbear thinking that these Flowers are very strange. Coral might have been without 'em much better than a great Number of Terrestrial Plants.

According to the Analogy of other Plants, it should seem as if those little round things that fall off from the Coral in the Sea did contain the Seeds thereof; but Monsr. *Marsigli* open'd them and found neither Seed, nor any thing that came near it in them; but only a glutinous Juice, like that he met with in the Bark. Besides, since Corral is fasten'd to the top of the Grotto, where it grows with its Heels upwards, and that those round things fall by their own weight to the bottom of the Water, it would be difficult for their Seeds to  
spring



spring upwards if there were any such in them, unless perhaps their weight should diminish, or that they should open and their Seeds being lighter than they, should ascend. But it is better to wave our Conjectures, and stay till time clears up this Mystery of the Seeds of Coral, which cannot be more surprizing than what has been before related concerning their Flowers.

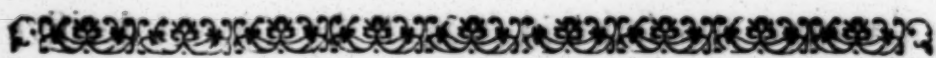
Monf. *Marsigli* observed, that the little Globules of the *Lithophyton*, that has Thorns upon it and no Bark, lengthen'd themselves, put out two Filaments at their top, and at last became kinds of Flowers, whilst the Plant was kept in the Sea-Water; but resumed their first Figure when it was taken out, and so *toties quoties*, in which respect the appearance was exactly the same with that of the Flowers of Coral, and it would last so two Days; but these Flowers, no more than those of Coral, contained any solid Seed in them.

The Class of soft Plants did a little better satisfy the Curiosity of Count *Marsigli*. He found one without any Leaves which had very fine Flowers, in six white Divisions, with six white Filaments and pretty large round Fruit, each containing six little yellow Seeds, and of a very sharp taste. He saw another Plant, the Cods or Shells of which were empty, and had probably shed their Seeds; On the other hand he met with Fruits fallen off from their Plants, one of which was like a Fig, having Seeds in it: Another was a kind of little Olive, and is said to be the Fruit of the *Algae*, and has a solid Nut or Stone in it. There are likewise some soft Plants, and particularly the *Plant-Bark* which disclosed no Seed, but in lieu of it there  
were

*upon the Manner how several, &c.* 423

were Flowers which appeared and disappeared again just like those of Coral, and of the thorny *Lithophyton*.

Thus we know the Flowers in each of the three Classes, and the Seeds in that of the soft Plants; considerable Beginnings in the Marine Botany, and wholly owing to *Monf. Marfigli*, to whom we shall probably be still more beholden for a farther Progress in these unknown Paths of Natural Philosophy.



*Upon the Manner how several Kinds of SHELL-FISHES fasten themselves to certain Bodies.*

When we treated of the progressive Motion of several Kinds of Shell-Fishes in the History of 1710, we took notice of the almost perpetual Immobility of some of 'em, for one cannot treat of their progressive Motion, without saying that the most part have none; and in that respect are more a-kin to Plants than Animals. There are even some of them that never once stir out of the place, where, as I may say, they first took Root. It is concerning their Immobility that we are now a going to speak, from *Monf. Reaumur*, Author of all the following Observations.

The *Goats-Eye*, a Shell-Fish so called, fastens its self by a very flat Basis to the smoothest Stones, and fastens its self to them so strongly, that being placed in a Situation in which the said Basis and the Stone were vertical, they were obliged to make

use of a Weight of 28 or 30 Pounds to make the Fish let go its hold. It is remarkable that the Basis which is Elliptick is not above an Inch in its largest Diameter. From whence then proceeds so great a Strength? It is hardly probable, considering the smoothness of both Bodies, that the Basis of the *Goats-Eye*, let it be never so Musculous, can sufficiently insinuate it self into the imperceptible Asperities or Ruggidness of the Stone; and in short, such an Insinuation would not have any great effect in a vertical Situation. And so likewise Monsieur *Reaumur* has satisfied himself by several decisive Tryals, that this Shell-Fish is so strongly fasten'd to the Stone by the means of a Glue that comes from it, and that even the Action of the Muscles of its Basis, which we may also add, has no share at all therein.

This Glue is yet more remarkable in the *Sea-Orties*, which do likewise joyn themselves no less closely to Stones. These Creatures are neither cover'd with Scales nor Shells, nor is their Skin a Membrane or Texture of solid Fibres, 'tis no more than the Skin or Film of a viscous Matter, which is immediately dissolved in Brandy, whilst the rest of the Body remains entire, and without alteration.

The 1520 Legs of the *Sea-Star* do not seem so much to be given to it in order to promote, as to retard its Motion. They are very soft, and serve to glue this Fish to the neighbouring Bodies; insomuch that you break them off when you attempt to unfasten them.

The *Sea-Muscles* have a way of fastening themselves, that is the most singular of all. They throw



throw out from their Bodies, Fibres or Threads as thick as a good big Hair, and at most as long as three Inches, and sometimes about the number of 150 of 'em; with these they lay hold on such things as are round 'em, and most commonly of the Shells of other Muscles. They throw them every way, and they hold themselves by them as by Ropes that have different Directions. Monsieur *Reaumur* did not only observe that they spun these Threads, and that when they were cut off they spun more; but he has likewise discover'd the curious Detail of the Mechanism they use therein.

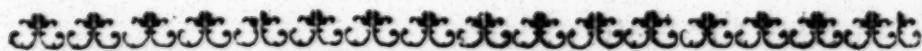
The *Marine Pinnes*, another kind of Shell-Fish, fasten themselves likewise by Threads much finer than those of Muscles, but in a much greater Number. People make fine Works with those, whereas the Threads of the Muscles are good for nothing. The *Marine Pinnes* may be accounted the Silk-worms of the Sea, and the Muscles the Caterpillars.

Lastly, the Worms that are called *Tube-Worms*, because being otherwise pretty like the Earth-worms, they are inclosed in a round Tube or Pipe of a shelly Substance, make themselves a Habitation which they never forsake, by fastening their Tube either upon a Stone or upon hard Sand, or or some other sorts of Shells. This Tube follows exactly the Compass or Windings of the Surface to which it is glued; rises or sinks with it, &c. It even creeps along without being obliged to it by this Surface, and because it seems to have followed the Natural Motions of the Worm. All this is explained of it self, in Mr. *Reaumur's* System, who

who pretends that this Tube, like the Shells of Snails, is formed of the viscous Matter that perspires from the Body of this little Animal.

Another Species of Sea-worms, which probably do not perspire so much of the like Matter, make themselves a Tube or Shell of nothing but the Grains of fine Sand and the little Fragments of other Shells which they glue together, and this little Building of chequer'd or inlaid Pieces, is nevertheless very neatly formed.

It is by the means of the like Glue that Oysters fasten themselves to Rocks, and even to each other; and in a word, this is the universal Cement that Nature makes use of whensoever she has a Mind, as one may say, to build in the Sea, or to secure any thing against the violent and perpetual Motion of the Waters. *The plainest and simplest Methods well applied are always the most effectual.*



### *Upon a New Kind of PURPLE.*

**H**ere are not only more Things found out in these latter Ages than were lost in former, but there can hardly any thing at all be lost that was worth the keeping: For in short, one need only seek for it in the Bosom of Nature where nothing is annihilated; and it is even a great step towards finding it again, to be sure that it can be found.

The Colour of Purple, formerly so highly valued, that it was one of the principal Signs of Dignity

Dignity among the *Romans*, either has not been, as was believed, quite lost, or at least was found again about thirty Years ago by the *Royal-Society* in *England*. One of the Shells from whence it proceeds, and which is a Kind of *Buccinum*, is common upon the Coasts of that Country.

Another *Buccinum*, which likewise yields the Tincture of Purple, and probably one of those described by *Pliny*, is found upon the Coasts of *Poitou*, and *Mons. Reaumur* enquiring into it more nicely found out another Purple where he did not look for it, and which according to all appearances was unknown to the Ancients, tho' of the same Kind with their own.

The *Buccinum* of *Poitou* that yields Purple, is commonly found among certain Stones or Sands, which are cover'd with Oval Grains of the length of three Lines, and of the bigness of a little more than one, full of a white Liquor, but enclining a little to yellow, not unlike that which is drawn from the *Buccinum* it self; this Liquor after some Changes assumes the Colour of Purple. After several Experiments and Observations, *Mons. Reaumur* is of Opinion these Grains are not the Eggs of any of the Shell-Fishes called *Buccinum*; neither are they the Seeds of any Marine Plant, they must therefore be the Eggs of some Fish. They don't begin to appear but in Autumn.

If you break these Grains upon a white Cloth, they only tinge it at first with a yellow Colour, and that scarce visible too, but in three or four Minutes it turns to a fine bright Purple, provided you expose it to the open Air: for (which is well worth observation, and which shews the exceeding



niceness of the Production of this Colour) the Air of a Chamber, tho' the Windows be open, will not suffice. The Tincture of these Grains is diminished a little, by frequent washing the Cloth.

Monf. *Reaumur* has discover'd by some Experiments, that the effect of the Air upon the Liquor of the Grains consists, not in depriving it of any of its Particles, nor in giving it any new ones, but simply in agitating and changing the Disposition of the Parts that compose it.

*Cockeneel* is a very fine red Colour, but it is only proper in Woollen, and is good for nothing either in Silk or Linnen.

*Carthame* yields a fine Poppy-colour and Crimson, but it is only proper in Silk. If one improves these Grains of Monf. *Reaumur*, one may find out a fine Red that is necessary for Dying Linnen, and which will perhaps exceed the Red of the *Indian* Linnens, which is not very fine.

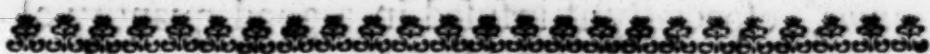
Monf. *Reaumur* compares his new Purple with that which is drawn from the *Buccinums* of *Poitou*. Those *Buccinums* have at their Collar or Neck (for we may allow them one as well as the Snails) a little Receptacle, or Vessel improperly termed a Vein by the Ancients, which contains no more than one good drop of a yellowish Liquor. The Linnen that is tinged therewith being exposed to a moderate Heat of the Sun, assumes at first a greenish Colour, then a Lemon Colour, next a brighter Green, afterwards a deeper, then a Violet, and last of all a fine Purple. This happens in a few Hours; but if the Heat of the Sun be very strong, the fine Purple appears at once without shewing the Preliminary Colours. A great Fire produces

produces the same Effect, only a little more slowly, nor is the Colour quite so perfect. Without doubt the Heat of the Sun, much more subtile than that of our common Fires, is more proper to agitate the finest Particles of the Liquor. The open Air does likewise operate upon the Liquor of the *Buccinums*, especially if infused in a good quantity of Water, but not so quickly; from whence Monsieur *Reaumur* conjectures with a great deal of probability, that the Liquor of the *Buccinums*, and that of the Grains, is pretty near of the same Nature, saving that the latter is more watry. They differ likewise in the Taste; that of the Grains is salt, that of the *Buccinums* extremely pepper'd and biting; perhaps because there is less Water used to it.

If one would make use of them in Dying, that of the Grains would be most convenient, and cost least, it being very easie to extract the Liquor from a great quantity of Grains, which might be bruised all at once; whereas to come at that of the *Buccinums*, you must open the Receptacle of each Shell singly, which would take up a great deal of Time; otherwise, if for Expedition you should bruise the smallest of those Shells together, the Colour would be spoiled by the mixture of different Matters that come together from the Animal.

One might perhaps find Chymical Preparations that could make the Purple appear sooner, or more easily than the Fire, the Sun, or the Air; and Mons. *Reaumur* has already produced such an Effect upon the Liquor of the *Buccinums* with the corrosive Sublimate, but practice, and especially that

which is required in an Art, must be established by many more Observations and Trials. There is a vast difference between a Naturalist that aims at Knowledge, and an Artisan that seeks nothing but Gain.



### Upon CORAL.

**N** S Count *Marsigli's* History of the Sea had awaken'd the Attention of the Chymists upon the Analysis of the Marine Plants, and especially of *Coral*; Monsieur *Lemery* has added an Account of some new Operations upon this Plant to those which he had already given in his Treatise of Chymistry. 'Tis those new Operations, or rather that which is most singular in them, which we are going to relate here.

After having used in the Dissolution of *Red Coral* either distilled Vinegar, or the Spirit of Venus, which is a Vinegar impregnated with some Volatile and Sulphurous Particles of Copper, Monsieur *Lemery* tried other Acids that were much stronger, such as the Spirits of Vitriol, Alum, Nitre, and Salt. These produce a much greater Effervescence and a more sensible Heat than the other weaker Dissolvents; and their Strength is a plain reason of such an Effect. Nevertheless, when one would make use of Coral in Physick, it is best to dissolve it only with distilled Vinegar, or the Spirit of Venus, which will make a softer Impression upon it, without exhausting its Alcaline quality



lity in which all its Virtue consists. Coral dissolved by the Spirit of Vitriol makes a kind of Vitriol, and accordingly the Colour of that Dissolution is greenish. The reason of which is, that the Acid of the Vitriol is incorporated with the Coral, as in a Matrix. When one precipitates dissolved Coral with Oil of Tartar, it is turned to a very fine white Powder: For as soon as it is minutely divided, it loses its red Colour. This precipitated Coral will still ferment with Acids, for in reality it has received no other Change but to be very much attenuated.

When it is in this Condition, tho' it were so only by simple pounding, a Knife touched with a Load-stone, will discover a great many Particles of Iron in it. But there are none to be found in Crabs-Eyes, in Pearls or Mother of Pearls, nor in Harts-horn even after calcining them, tho' all these Matters do by Chymical Analysis pretty much resemble that of Coral. It is true, they are the Production of living Creatures; whereas Coral is a Vegetable. *But from whence should a Marine Plant, that is only fed by Water wherewith it is surrounded, get Iron? or which is most surprizing, to find Iron in Coral, or in Honey?*

Tho' the true Salt of Coral be either a Volatile Alcaline and Urinous Salt, which is extracted from thence by Distillation, or else a fixed and Alkali Salt, produced by Calcination and Lixivation, the Chymists do not call any thing Salt of Coral, but such a Coral as is penetrated by Acids, and condensed afterwards by the Evaporation of the Moisture. When this Evaporation is almost at an end, the Liquor assumes a greenish Colour, which

Monfieur *Lemery* attributes to the Vitriol, or which is the same thing almost, to the Iron contained in the Coral. This kind of Chryftallization of Coral is made in little fine Branches, interlaced with each other in such manner, that they make an agreeable appearance of a little Forest. A Chymist, inclin'd to the Rosicrucian Temper, would easily mistake this for one of those boasted *Palingeneses* or Resurrections, in which the mixed Bodies uncompounded and reduced to their first Principles revive from their Ashes, and resume their former Figures; but the Mischief is, the same thing equally happens to all the Salts drawn from Crabs-Eyes, Pearls, Harts-horn, &c. they all turn to Forests, tho' their Mixtures had not the least Resemblance thereto.

Hitherto the Question has been only about Red Coral; the White, if it be a Coral, and not a *Madri-pore*, appears to be pretty much of the same Nature, and should be applied to the same Uses in Physick: Only it seems to be more porous and spongy; accordingly it ferments less briskly with the same Dissolvents which find it more open. Probably the red Colour proceeds from a Sulphur that stops or contracts its Pores.

As for what they call Black Coral, it is none at all, but only a kind of *Lithophyton*.



## Upon TRUFFLES.

*Since there are Animals that have hardly any thing of the Nature of Animals in them, we should not think it strange if there be Plants that hardly deserve to be ranked among the Number of Vegetables : It seems as if every Species were to begin by the infinitely Little of the same ; that is to say, by those that have least of the Marks or Characters of them, and from thence to rise gradually till you come to those that are the most Perfect.*

Truffles have neither Roots nor Fibres that may supply their place ; nor Stalks, nor Flowers, nor any appearance of Seeds : Nevertheless they certainly are Plants, and the less they appear so, the more should they excite the Curiosity of Botanists ; and accordingly, *Monf. Geoffroy* the younger, has undertaken to examine them with a particular Care. All that he could discover in them, that might induce him to believe them organized Bodies, was the Marbling they assume, after having been altogether, and very uniformly white throughout their internal Substance, which was cover'd by a dark or brown Skin. This Marbling can only be occasion'd from some Parts becoming brown or black, whilst others preserve their former whiteness ; and this sufficiently proves the difference of those Parts, which is not visible but at a certain Degree of Maturity. Some of these Parts must be Vessels, and perhaps all of 'em may be different

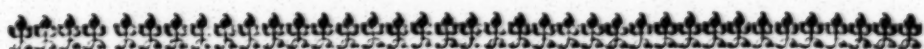


ones. If you nicely trace the white Parts, you may see them extended from the Centre of the *Truffle* quite to the Circumference, and to the Skin it self; and it is from thence *Monf. Geoffroy* conjectures that they are rather real Channels; and as the brown Substance appears thro' a Microscope to be all formed of little Vessels, that may be the Flesh and Pulp of the Fruit. This Pulp is sprinkled with an infinite number of little Points, black, round, separate, inclosed in the little Vessels, and which one might take for Seeds, because in short one finds nothing else that has the least appearance thereof.

*Truffles* which never spring out of the Earth may therefore be compared to a Marine Plant, since it is encompass'd on all Sides with its Food, which it attracts by the Pores of its Skin; and as it is for this reason that the Sea-Plants have no Roots, so neither have the *Truffles* any need of them. This Plant appears at first just like a little round Pea, red without and all white within: It still preserves its round Figure as it grows, because it draws its Nourishment equally on all sides. If it be true, that a little Piece of Money was found in a *Truffle*, as *Pliny* relates, one may easily conceive that it was no hinderance to its attracting the Juices of the Earth, excepting by those Parts upon which the Money lay, and that the other Parts growing in the mean time, extended themselves every way over it, and so at last inclosed it. When the *Truffle* by being over-ripe rots in the Ground, the little Vessels that contained the invisible Seeds shed them; and these Seeds, the only Remains of all the Substance of the Fruit, being

being gather'd in several little Heaps give Birth to new Truffles, which did therefore grow a good many of 'em together.

By all the Chymical Experiments *Monf. Geoffroy* made upon Truffles, they appear to abound with a Volatile Alkali-Salt mixed with Oyl; he could find no Acid in them, from whence it comes probably that there is such a great Evaporation of their Odour; those Principles of this mixed Body, which are the lightest and most subtile in their Nature, having nothing to bind and unite them to each other. But we will enter no farther into this Matter, nor into all other Enquiries or Reflections of *Monfieur Geoffroy*; our only Design was to shew how a Truffle might be esteemed a Plant. *The most surprising Varieties, as soon as they are fathomed, are found consistent with the Uniformity of the general System of Nature.*



Upon the Nourishment of P L A N T S.

**T**HE Vegetation of Plants is more obscure than that of Animals; there is not indeed much Skill required to find out that they draw their Food from the Earth by their Roots, but when that is done, all the rest is sufficiently hidden. We know not the way of the Juices, that nourish and circulate in the Plants, as we do that of the Blood; and the Tubes and Channels thro' which they pass, are neither so obvious or visibly distributed, as are the Blood-Vessels. In a word,

word, the Uncertainty is so great, that it is still doubted whether it be chiefly by the Bark or by the Pith, or in those that have no Pith by the woody Parts that Plants are nourished.

The Common Opinion has hitherto been for the Bark, but *Mons. Parent* has already opposed it, by the Example of an Elm in the Gardens of the *Tuilleries*, which lived and produced Leaves, tho' it was entirely stript of its Bark from Top to Bottom; he has now added other Experiments and new Reflections.

He saw in the Garden of *Luxenburg* four Elms, which, with a design of killing them, had been stript of their Bark to the Quick, beginning at a little Heighth from the Ground, without leaving but a very little towards the top of the Trunk, and in one of the Four none at all: They lived notwithstanding four or five Years, and put out both Leaves and Flowers.

The Plantane and the Cork-trees shed their Bark and get a new one, just as the Serpents do; in the Interval, between the old and the new Bark, it is plain they can have no nourishment from thence, and consequently that they never have. It is true, there is a new one formed under the old, as the latter is loosening in order to fall, but this young and weak Bark does not seem proper to nourish the whole Tree.

There are Trees, as the *Elder*, the *Vine*, &c. which have a great deal of Pith and little Bark, and this seems to prove already that they receive their Nourishment from the former and not from the latter; but besides, as they grow old, they are full within of Wooden Fibres, which appear in the  
place



place of the Pith, from whence one may suppose both that the Pith is properly by its Nature to form Woody Fibres, and also consequently to supply the Wood with its nutritious Juice, and that it is the Pith effectively that does it, since the Tree ceases to grow, and to be plentifully nourished, and in a word, becomes old at the same time that the Pith diminishes.

The Grafts cannot take hold without being joyned to the Woody Parts of the Tree; 'tis then from those Parts that they receive their Nourishment.

If it were the Bark that fed the Tree, then the new Woody Substance which is formed would come out of it; and if on the contrary, it be the Trunk, the new Bark would proceed from it. Now we find under the Bark of old Elms, *Strata*, or Beds that have been lately formed; the only question then is, to know whether these belong to the Bark or to the Trunk; in the first Case the Trunk must have given them, as I may say, to the Bark; in the Second, the Bark must have given them to the Trunk. *Monf. Parent* pretends that they belong to the Bark, both because they are sometimes wholly loosened from the Trunk, tho' strongly glued to each other, and also because they are perfectly of the Nature of that fine Bark or Vellum which is under the coarse one. We see still more plainly in the *Chinese Palm-Tree*, that this thin Vellum is destined to form the Bark, which is nothing but a Reticulary Texture, which being drawn out and extended in its Breadth, resembles a very clear and thin Cloth; but if it be drawn out Lengthways, it makes a kind of Cottony Ribband, very close

close and very strong, which is used by the *Chinese* for Ropes. This kind of Texture, is not consistent with a Ligneous Body, which does not appear to be any thing else but a heap of Longitudinal Fibres, disposed Cylinder-ways, one against the other.

The most part of the Knots which we see come out of the Pith of Trees, and which are often cover'd over with Woody Fibres, shew that the Branches derive their Origin and Nourishment from the Pith.

Notwithstanding all this, *Monf. Renaume* persists in his Opinion, that the Bark is more necessary for the Nourishment of the Tree, than the Pith or Woody part, which, however, he does not exclude from that Office. For a Proof of which, he gives an Instance of some hollow or rotten Trees, which had no more Wood remaining in their Trunk than was just sufficient to support the Bark, and yet were alive and fertile too. He now returns his Answer to the Principal Facts alledged against his Opinion.

Parts of a Tree separated from their main Body, may carry away along with them such a Provision of Nutritious Juice as will cause them to Vegetate alone, in which case they are very different from the Parts of Animals, that cannot subsist without being united to their Whole. Thus Branches of the *Elder*, of the *Willow*, &c. tho' cut off, will put out Leaves, and little Branches, without being planted again in the Earth. Sometimes pieces of Wood, that appear dry, will do the same; the Cause whereof must be, that the Air being heated to a certain convenient Degree, Subtilizes and Agitates

tates the Juices that were deposited in those Parts, seemingly Dead. This Action of the Air is very sensible in certain *Bulbous Plants*, which cannot spring from Seeds but very difficultly; for if you would get Seeds from them that should not be abortive, but come to good, you must cut off the Stalks and hang them up in the Air a certain time, after which, the Seeds that come from thence will be fruitful; the reason of which is, the Juices of these Plants are too Oily and Glutinous, and so cannot insinuate themselves easily into the fine Vessels of the Seeds which they are to unfold and open; and therefore it is necessary that they should be first attenuated and render'd more Fluid by the Air. If Branches that are cut off will vegetate, much more will those that remain upon the Tree, and which can never be entirely deprived of new Juices; for tho' there should no more arise by the Bark when taken off, and which is supposed to furnish them therewith in a larger quantity, they will still receive some by the Woody Parts, and especially by the *Aubier*, which is the most tender of those Parts, and the most like to the Bark.

So *Monf. Renaume* resolves the Example of the Elm in the *Tuilleries*; it vegetated without Bark during one whole Summer, by the help of that Provision of Juice which it had kept; and as *Monf. Parent* agrees that it had less strength than the rest, *Monf. Renaume* thinks that he has a right to conclude from thence, that its Provision being spent, it was about to die, and therefore the Gardener did well in cutting it down.

The same Principle furnishes *Monf. Renaume* with an Answer to what had been related from  
*Monf.*



Monf. *Magnol*, in the History of 1709. A Graft of an *Olive-Tree*, from which they had taken about 3 or 4 Fingers breadth of the Bark quite round, bore that Year, above the place that was stript, a double quantity of Flowers and Fruits to what it was used to do. It is easie to see why that Tree vegetated in spite of the stripping off the Bark, and it is so much the more easie to be conceived, as that Plant is very Oily, even in the Substance of its Wood; and that Juices of this kind are more easily kept in reserve. The whole Difficulty is to know, why the Vegetation was more copious; since, on the contrary, the Reasons are plain why it should be much less.

Monf. *Renaume* pretends that the Seeds from whence the Flowers and Fruits are to spring, are formed at the same time with the young Branches that bear 'em, for the old Wood has never any; that the Buds in which these Seeds are inclosed, are easily distinguished from those that are to bear nothing but Twigs; and that the Gardeners cannot be mistaken therein, that these Fruit-Buds do therefore only want to be unfolded, which sometimes never comes to pass perfectly, but in the Second Year; that it is possible, that when, besides the Juices they have in reserve, new ones ascend by the Bark, they open in a lesser Quantity, because there is too much Juice; and that on the contrary, when there is less by the stripping the Bark, and consequently when it is more attenuated by the Air, the Juice does the more easily insinuate it self into the little Vessels, and gives Birth to a greater number of Flowers.

This

This Answer of *Monf. Renaume* does likewise solve what *Monf. Bernard* had proposed against his Opinion in his *Nouvelles de la Republique des Lettres*, for the Month of Nov. 1708. 'Twas a Fact almost exactly like that of *Monf. Magnol's*.

*Monf. Renaume* relates another, and a very singular one, which he had from a Man that was skilful at Cultivating of Trees. About the Cities of *Aix* and *Marseilles*, when an Olive-tree is worn out, and that they intend to cut it down in some Years, they have a way of forcing from it beforehand, all the Fruit that it might have contained within, and which it would not have otherwise put forth of it self; they take off from one of its young Branches a good Inch of Bark all round, and in the place of it they put another piece of Bark, stripped from a Branch of a young fresh *Olive-Tree*, of the same size exactly with that which is taken off from the other. They take care likewise, as you may easily imagine, that that which was the upper or lower Parts of the Bark belonging to the young Olive-Tree be exactly applied in the same Situation upon the old one; this being done, they dress the Tree after the same manner as in Grafting, to the end that the Wound may heal, and the strange part become Natural. In order to cut the two Barks more equally, they have a crooked Knife, composed of two Blades exactly parallel, and distant an Inch from each other, and joyned in the same Handle. The Branches of the old Olive-Tree thus grafted, bear Fruit most abundantly the following Years; and those of the young one, that had been stripp'd of part of their Bark, wither unless you cut 'em.

This

This last Fact is entirely conformable to the Opinion of *Monf. Renaume* ; and it is likewise a Consequence of it, that the Bark of a young Olive-Tree, grafted upon the Branch of the old, produces more than even the Bark of the old would have done; because, according to him, it is the Bark that contains the Buds ; and it is very natural that the Bark of a young Tree should contain more and more vigorous ones than that of an old Tree, tho' it belongs to a young Branch. But this Branch of the old Olive-Tree, which produces more Fruit, does not only produce more upon its new Bark, but likewise above it, and for that it is necessary that the Juices in passing by the new Bark, should have acquired a Disposition, and some Virtue which they would not have contracted in the proper and natural Bark of the Branch. This is not hard to be conceived ; the Young Channels are more free and open than the old ones ; and the young Filters or Sieves do best perform their Office of Filtration ; both one and the other are stopp'd in time, because some Particles of the Liquors that pass thro' 'em always stay behind, and it is very likely, that from thence proceeds both the old Age and Death, as well of Plants as Animals.

As all these Arguments suppose a Certainty of Observations, *Monf. Renaume* declares, that he would not be satisfied till they were all fully and absolutely verified, and that he still labour'd to procure Confirmations and necessary Lights therein. He himself has examined the Elms of *Luxemburg* mention'd by *Monf. Parent* : He found that in that which appeared to have no Bark towards the upper part of the Trunk, there did remain some Fibres of



the Internal Bark, or Vellum, or *Liber*, call it which you will, and that they had a Communication with the Bark of the Branches. Those Fibres, thro' which had passed all the Juice destined to the Bark that subsisted no longer, did probably nourish the Branches of the Tree, and make them vegetate ; and besides, by the abundance of their Nourishment, which they thus received, they were strengthen'd to such a Degree, that they began to make a new Woody Substance. Other Fibres of the same *Liber* that were younger, and perhaps not formed till after the stripping of the Bark, made a new *Aubier* entirely separate both from the first Fibres, and from the Woody Body of the Tree. This *Aubier* began already to be cloathed with a new and a thin Bark. The Gardener, who saw that his Tree made new Efforts to live in spite of him, cut off some of these new Productions, of which Mons. *Renaume* shewed a Part to the Academy. There remained, others which still caused the Tree to grow. Mons. *Renaume* proved by several Instances, that a very little of the Bark or *Liber* was sufficient for the same purpose. Mons. *Maraldi* related that a Graft of a Plum-tree having been broken in such manner, that it only held by a part of the Bark, and being afterwards raised and supported, produced both Wood, Flowers and Fruit, by the Juices it received from the small Remnant of the Bark, notwithstanding that the Woody Part, which had been broken, was become rotten.

From this same Observation of the Elm of *Luxemburg*, Mons. *Renaume* concludes, that it is the Bark or the *Liber* that forms the *Aubier* ; and as the *Aubier* is the last Wood formed, he infers, that all the Wood is formed of the *Liber* or of the Bark.

We must conceive the Liber as composed of several Surfaces or Beds, Cylindrical and Concentric, the Texture of which is Reticular, and in some Trees can be really extended or drawn out like a Net, because the Fibres that form it are soft and supple. Whilst they are in this Condition, either they are hollow, and so are true Channels; or if they are solid, their Intestines perform that Office. The Nutritious Juice which they continually receive, and part of which they intercept and keep, makes them grow in Length and Bigness, strengthens them, and brings them nearer to each other. One may suppose that the Longitudinal Fibres are those which grow the fastest; so then that Contexture, which was at first Reticular, becomes a Collection of streight Fibres, whose Position is vertrical and parallel with one another; and in short this is the Woody Substance. This Change is greater in the Beds of the Liber that are nearest to the last Pith, and consequently 'tis the most internal Bed, which is the first that is glew'd or fastened thereto, and that becomes a new *Aubier*.

It may be objected against this Motion, that the most internal Bed is the thinnest, and for that reason does not appear the most forward, the most unfolded, and the most disposed to be converted into Wood. But *Monf. Renaume* answers, that the others are not thicker, but because they are less unfolded, and remain still composed of several Beds which have not had the time to separate themselves by growth from each other.

About the End of Autumn, the Liber is already adhering to the *Aubier*, and in Winter you can scarce be able to separate it; the Juices that are both thick of themselves, and more by the Dissipation

tion of the Watry Parts they contained, are that Glew which Nature makes use of for this purpose. Whilst the *Aubier* preserves any Softness or Suppleness, and has still a little of the Nature of the Bark, it may support the Vegetation for a while; but when it is absolutely turn'd to Wood, it can be no longer of that use. The Vegetation of the young Branches is the most lively, and that which alone extends it self even to the Flowers and Fruits, because those Branches are as yet hardly any thing but Bark.

In proportion as the Woody Substance of the Trunk becomes more Woody, the Pith is compressed and restricted to such a degree, that in some Trees it is quite annihilated. From hence also *Monf. Renaume* concludes, that it cannot be very necessary for Vegetation, since its use is not perpetual. As the Pith is spongey, he supposes it may serve to receive the superfluous Moistures that transpire by the Pores of the Woody Fibres; and if thro' the Excess of those Moistures, or from some other Cause it should rott or be corrupted, as it often happens to Elms, the Trees would nevertheless grow and vegetate, which is a pretty strong Proof of the little occasion there is for the Pith.

This is in general the Mechanism of the Vegetation of Plants, according to the System of *Monf. Renaume*: If we should enter into a greater Detail, we could likewise add more Conjectures and more Uncertainties. One might go even to the *Ventricles*, *Insertions* and *Trachea's*, Parts of Plants which Authors of great Name indeed have endeavour'd to establish, and which, perhaps, may exist; but which we cannot see with the best Microscope any otherwise than as we are inclined to see them.





### Upon B E E S.

*AS Ancient and Eſtabliſhed as is the Reputation of the Bees, they were not yet eſteemed ſuch wonderful Creatures as they now appear; and we may ſay of them what has been ſometimes ſaid of Deſerving Men; that they get by being known. Monsieur Maraldi, who has obſerv'd them with great Application and Affiduity for many Years, has given a very advantageous and very circumſtantiated Account of them, which we ſhall reduce to the moſt important Points, and moſt eaſily underſtood.*

The Bee does equally extract its Honey and Wax from Flowers, but not with the ſame Organs. As Honey is a kind of Liquid Matter, which comes out of the Flowers by Tranſpiration, the Bee ſucks it with a Trunk or Snout from the bottom of the Cups of the Flowers; but ſhe meddles with none whoſe Cups are deeper than her Trunk is long, which ſhe doubles and folds up at ſuch times as ſhe makes no uſe of it in gathering Honey. The Liquor thus extracted, is conveyed into a Bladder tranſparent enough to ſhew the colour of it on the outſide. Some part of it ſerves for the nourishment of this little Creature, and is diſtributed in the Veſſels of its Body. We ſhall ſhow what becomes of the reſt in its proper place. As for the Wax which is made of the Duſt of the *Stamina* in the Flowers, the Bees takes it up in the foremoſt of their Six Paws, and convey it into a little Conca- vity which they have in the two hindmoſt, and ſo they

they carry it away. They often compress and thread it with their Paws both for the Convenience of carrying more, and likewise to give it a Figure proper for Transportation. Sometimes they roll themselves in the Flowers when they are wet, by which means the little Particles of Wax stick to the Hairs of their Body, and so they are loaded all round. When the Bee returns to the Hive with its Harvest, she either discharges her self immediately of her Burden, if she can, or else does not fail to be assisted by her Companions.

Their Design in gathering Wax is to make a wonderful Structure of it, which is called a Comb; it is from thence that the Bees have been always admired, and they are more wonderful upon that account than has been yet believed. The choice Hexagon Figure which they give to the little Cells in their Comb, would be worthy of the best Geometricians, who know, both that such a number as they please of those Figures fills a space without leaving any void, and that this same Figure, which has that in common with a Square and an Equilateral Triangle, has still the advantage beyond it of enclosing a greater Space within the same Bounds: But this choice of the Hexagon Figure is nothing in comparison of what follows, amongst all the Geometrical Methods that could be put in Execution, they do at the same time make use of that which is both the most Simple and the most Convenient for themselves, and surely such a Choice as is the most Ingenious. What could the most able Geometricians do more? The Detail of the Construction of these Hexagon Cells, which Monsieur *Maraldi* has most nicely observed, was not yet known; nevertheless, that which does

not exceed the reach, and, as I may say, the Genius of these little Insects is too Geometrical and too Complicate to find a place in this general Account thereof.

Tho' there only appears in the Hive a continual and irregular Motion of Bees, skipping about without any Design, yet at the Bottom it is all in great Method and Order, but it must be carefully studied. Their Tasks are divided among them as with the *Beavers*. Some Bees bring Honey between two Fangs or Jaws which they have in their Head, from whence perhaps they derive a Liquor which moistens and softens it; sometimes they are the same Bees, who of the Wax, which they have thus prepared, raise the little Walls of the Hexagon Cells; sometimes that Office is performed by others; but in short, those that make the Walls are distinct from those that polish the Work, and it is another set of Labourers who execute that Commission, by making the Angles more exact, smoothing and plaining the Superficies, and putting the last Hand to it: Now as this is not done but by cutting of some Particles of the Wax; and as the Bees are mighty good Husbands, there are others who take care to carry off those Particles, which you may be sure will be none of 'em lost. Monsieur *Maraldi* has observed, that those Bees which build the Walls don't Work so long a time as those that polish 'em, as if the Labour of Polishing was the least fatiguing.

Their Dilligence is extream; a Comb of a Foot in length, and of Six Inches in breadth, and which contains near 400 Cells, is dispatched in a Day; it is true, that in such a Case all the favourable Circumstances must be concurring.

They



They fasten a Comb to the Top of the Hive, from whence it hangs down, but this is only in case that the Top or Cover of the Hive is not separable from the other part; for if it be, they will find out and fasten their Comb elsewhere. It is not properly Wax that they make use of in fastening their Combs. They are not so Prodigal, it is a very Course Glew that does it.

As the Combs are Planes perpendicular to the Basis of the Hive, which I suppose to be circular; if there should be one, the Bottom of which were a Diameter, or an entire *String* of that Basis, it would divide the Hive in two Parts, which could have no Communication with each other. The Bees prevent this Inconvenience, by not making their Combs of so large an Extent, and by leaving between two neighbouring Combs, which are pretty near upon the same Plane, a space by which two Bees can pass together on a Breast. Besides, they leave some Openings in the same Comb, that they may not be forced to go too far about.

The Cells of the Combs are destined to two Uses; the first is for their Magazines: They keep in them the Overplus of Honey, which is to serve for their Food in Winter: For of that which they suck from the Flowers, and which passes into the little Bladder abovemention'd, there is but a small Share that is applied to their actual Nourishment; they discharge the rest when they return to the Hive and make their Provisions of it. Moreover, they keep in the Cells already made, the Wax that is to be employ'd in the Structure of others, or to serve for other Uses.

Secondly, these Cells are the Cradles of their little ones. But whence come those little ones? it is one of the greatest Difficulties in this whole Matter to find that out.

The fabulous Traveller, who speaks of a Nation where there is no distinction of Sexes, and where he could not discover the Propagation of their Species, did perhaps borrow that Notion of the Bees; and *Virgil* was not to blame for praising their Chastity, and even believing the Story of the *Bull* for want of a better. In a whole Hive composed of 9 or 10,000 Bees, there is but one perhaps that brings forth Young. She is longer, and of a brighter Colour than the rest; she has a grave and majestick Gate, and this is the Bee they call their King: There are sometimes found two of 'em in one Hive, and at most but three of this same Kind, which makes it doubtful, whether there is more than one of 'em to whom the Privilege of Generation belongs; for by *Monf. Maraldi's* Observations, it is certain that it only belongs to the Royal Family. All the Subjects are condemned to Barenness.

This King commonly produces her young ones in the most secret Places of the Hive; but when by good Luck she makes choice of some that are more visible, it is even then very hard to see her; because the Bees, her Subjects, draw a Curtain before her. This Curtain are they themselves suspended from the top to the bottom, and fasten'd to each other by certain little Hooks which they have upon their Feet: By these means they make in the Air what Figures they please. The King does thus hide himself, either thro' Care for his  
little

little ones, or else perhaps out of Modesty; for there is no good thing, but one may think it of these Bees. However he could not always hide himself from *Monf. Maraldi's* Eyes. He observed him follow'd by his Courtiers, always in a grave Posture, and saw him lay in 8 or 10 Cells one after another as many little white Worms, which were to become Bees. Whilst he was hatching, it appeared by certain particular Motions of those that attended him, that they caressed, applauded, or encouraged him. After that he retires into the hindmost part of the Hive, from whence he scarce goes out.

By these 8 or 10 Worms which he lays at once, and in so short a time, and by the other Circumstances that *Monf. Maraldi* observed, one may judge of his Fruitfulness, during the whole time that he is not seen, that is to say, almost all the Year. It must be prodigious, when he is alone in a Hive, which is most common, 'tis he alone that produces; there comes out of this Hive one Swarm at least every Year, which may consist of about 14 or 15,000 Bees; Sometimes there comes two and even three in a Year, and yet the Hive is as full at the end of Summer as it was in the beginning of the Spring. A new Swarm therefore, if it be the only one of the Year, must be all young Princes, supposing that there come in none but young Bees, and in case there should come in old ones, there remains in the Hive a Number pretty near equal to those produced by the King, which is the same thing. It is not probable that the King, which goes out of the Hive with the new Swarm, has produced any part of the Bees that



that accompanied him : And if there goes out of the Hive more than one Swarm in a Year, these new Productions must still be placed to the account of the old King ; unless to save the Extravagancy of his Fruitfulness, one may suspect that he has produced more than one King ; that but one of 'em goes out with the first Swarm ; and that the other, or the two others, remain in the Hive, and there produce their Worms. If this be so, a King may go out with a whole Swarm of his own Production, and may be literally stiled the Father of his People ; whereas the other King's are only the Brothers, since they proceed from the same Bee. But let it be understood in what sense one will, these little Animals have the peculiar Privilege, that Nature it self bestows a King upon them.

What now remains to be known, is how this Fertility of the King is brought about, and whether it be by Coition. There are hardly any Hives in which we do not find Drones, and in some there are even Hundreds of 'em. They are of the same form with the Bees, only about one Third longer and bigger, and have no Sting ; they have nothing of the laborious Nature of the Bees, but live entirely Idle ; neither do they go out of the Hive but very seldom and in fine Weather, they return soon Home, and bring nothing with them ; not but that they are found full of Honey sometimes, but then they are suspected to have robbed the Hive of it, for they are never seen to settle upon Flowers ; and if they should at any time gather some Honey, it is only for their own Use, and not for the Publick Good ; for Mons. Ma-

*raldi*

*raldi* having squeez'd them, observed that Honey would not come out as it does from those of the Bees, and consequently the Drones can't discharge it. It might be thought that these Animals were the Males of the great Bee, or King, and that they would not be endured in the Hive, but only because their Laziness is abundantly balanced by this important Function. And that which might support such a Notion is, that at the end of the Summer the Bees make War against the Drones with great Violence, kill them, or drive them out of the Hive without giving Quarter, so that it is not known what becomes of them: It should seem therefore that the reason of this Catastrophe among them is, because they are become entirely useless, since there is no engendring in Winter: But that which makes the Difficulty is, that Monsieur *Maraldi* has observed some Hives without any of these Drones in Summer, and at a Time when the Cells abounded with the little Worms.

The Mystery therefore of the Generation of Bees do still remain, but the care which they all take in common of the little ones that are none of their own, and which belong only to their King, is very visible and very remarkable; it may be said that they consider them as the Children of the State. In every little Cell in which there is a Worm, they put some Drops of a Liquor for its Nourishment, then they make a Cover of Wax for the Cell; these different Operations have their stated Times, and are without doubt adapted to the Occasions of the Embrio. We shall leave the Detail of them to Monsr. *Maraldi*, as also the Account of the successive Growths of the Worm, which

which at last becomes a Fly, breaks thro' the Cover of its Cell, and after a little time of Languishing flies away with the rest. You must observe that the Bees have such a Spirit of OEconomy, that they will not even suffer the broken Covering of the Cell to be lost, they therefore carry it away into their Common Magazine, to be used upon a fresh Occasion : At the same time they reduce the little Cell to its regular Figure, if it has been any way impaired, and put it in a Condition to be used for the same Purposes again : In three Months time there have been five successive Litters of Worms in the same Cell.

The Drones proceed from the King as well as the Bees. There are in the Combs some Cells bigger than others, made for those Worms that are to be turned into Drones, and which consequently take up more room. These Worms are laid by the King with the same Ceremony, and afterwards treated by the Publick with the same care as those that are to become Bees. There is no difference till the end of Summer, but when that Time comes, the Bees declare War against the Drones, their Rage extends even to those that are yet but Worms, they break the Covers, which they themselves had made for the Cells that inclose them, and drag them out to butcher them, and then throw their little Carcasses out of the Hive : a Revolution hard to be understood in so wise a Nation. *If we should add all that is wonderful in this Insect, it would carry us too far ; and how many other Insects are there whose Wonders we don't yet know ? and how many more that will for ever be concealed from us ?*

F I N I S.



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